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AIR FORCE FLIGHT DYNAMICS LABORATORY
DIRECTOR OF LABORATORIES
AIR FORCE SYSTEMS COMMAND
WRIGHT PATTERSON AIR FORCE BASE OHIO

A USER'S MANUAL FOR THE

SEQUENCE ACCOUNTABLE FATIGUE ANALYSIS

COMPUTER PROGRAM

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FORWARD

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This Technical Memorandum has been reviewed and is approved.

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ABSTRACT

This report presents a detailed description of a computer program to calculate cumulative damage of notched structural members subjected to arbitrary spectra. The Sequence Accountable Fatigue Analysis computer program develops its sequence sensitivity by tracking residual stresses local to a notch throughout the spectrum of loads. Residual stress relaxation analysis is included to increase the generality of the results. An example spectrum and resulting cumulative damage analysis are illustrated.

TABLE OF CONTENTS

SYMBOLS

σ_{res}	Residual stress
σ_{max}	Maximum local stress level
σ_{min}	Minimum local stress level
σ_{ys}	Yield stress
$\sigma_{res_{EQ}}$	Equilibrium component of the residual stress
ε_t	Local strain, total
ε_e	Elastic component of total strain
ε_p	Plastic component of total strain
S_{max}	Maximum applied stress level
S_{min}	Minimum applied stress level
S_{mean}	Mean applied stress level, $(S_{max} + S_{min})/2$
K_t	Elastic stress concentration Factor
D	Damage
I	Integer describing the level number
N_{EP}	Equilibrium period, number of cycles for the local stresses to return approximately to the equilibrium conditions following an overload
C1	Residual stress relaxation constant
E1, E2	Relaxation function exponents
N	Number of cycles
E	Modulus of elasticity
N_f	Number of cycles of life at a given stress or strain cycling level
ε_f'	Strain intercept at one reversal on a log ε_p-log life curve
c	Slope of the log ε_p-log life curve

SECTION I

INTRODUCTION

Cumulative damage analyses based upon the local stress-strain behavior at a notch appear to be reasonably successful in anticipating trends in fatigue life behavior of notched specimens subjected to spectrum loading [1-6]. The type of behavior that usually occurs is that peak tensile loads tend to increase the fatigue life and peak compressive loads tend to decrease the life of notched structures compared to structures experiencing load spectra not having those peaks [5,6]. Local behavior analyses, such as those developed by Smith [7] and Neuber [8], help to explain this phenomenon as being a result of the tensile peak load creating a compressive residual stress at the notch and, conversely, the compressive peak creating a tensile residual stress. The change in life occurs because the residual stress state modifies the subsequent damage accumulation rates.

The Sequence Accountable Fatigue Analysis computer program was developed to incorporate the local stress-strain approach with a recent residual stress relaxation analysis [6] in order to improve the sequence sensitivity of cumulative damage analysis. This technical memorandum presents the details of the resultant computer program and an example of its use. The correlation of predictions made with this analysis to actual results of tests experiencing spectrum loading is presented by Potter [9] and Potter and Noble [10].

SECTION II

PROGRAM OUTLINE

The Sequence Accountable Fatigue Analysis traces the stress-strain behavior local to a notch throughout an applied load spectrum and calculates the damage based on the local experience. The computer program is divided generally into the four parts or modules outlined in Fig. 1.

The basic input data for the material, specimen geometry, fatigue behavior qualities and spectrum, are developed in Module I. Module I is discussed further in Section III. Module II takes the input information and determines the local stress-strain behavior. Module III references the Range Pair Counting Method Subroutine to cycle count the local stress spectrum. Module IV determines the damage in the local stress-strain spectrum.

The basic analyses used in Modules II, III and IV are presented below.

Module II - Local Stress-Strain Behavior - The analysis used during the determination of the local stress behavior during the spectrum of loading is a combination of analyses developed by Smith [7], Neuber [8] and Potter [6]. Smith's simple analysis indicated that the residual stress could be approximated by assuming that the initial stress-strain behavior was elastic upon unloading following plastic flow. Thus, the residual stress could be calculated knowing the

maximum local stress and the maximum applied stress as in Eq. 1 and in Fig. 2.

$$\sigma_{res_i} = \sigma_{max_i} - K_t S_{max_i} \qquad (1)$$

The Sequence Accountable Fatigue Analysis computer program currently incorporates elastic-perfectly plastic stress-strain behavior. Therefore, σ_{max_i} is equal to the yield stress. For the cycles immediately following the peak stress, the residual stress determined in Eq. 1 modifies the elastic solution as shown in Eqs. 2 and 3 (provided that the following maximum applied stress is less than S_{max} and that there is no change in the residual stress due to a minimum applied stress causing reversed yielding).

$$\sigma'_{max_i} = \sigma_{res_{i-1}} + K_t S_{max_i} \qquad (2)$$

$$\sigma_{max_i} = \sigma_{res_{i-1}} + K_t S_{max_i} \qquad (3)$$

The analysis developed by Neuber [8] has been extended to cyclic loading by Wetzel [2] and Wetzel, Morrow and Topper [3] and used by many others [1,4-6] primarily to determine local stress-strain behavior. It is used in this program only to calculate plastic strains occurring when the residual stress undergoes a step change. The plastic strain calculation routine is accessed only when the σ_{max_i} or σ_{min_i} terms in Eqs. 2 and 3 exceed tensile or compressive yield stress levels, respectively. Figure 3 illustrates the calculation of the plastic strain.

The local stress-strain behavior, according to Wetzel [2] is related to the applied load by Eq. 4

$$\sigma \cdot \varepsilon = (K_t S_{max})^2/E \qquad (4)$$

The plastic strain can be found by subtracting the elastic component from the total strain.

$$\varepsilon_p = \varepsilon_t - \varepsilon_e = (K_t S_{max})^2/E \cdot \sigma_{max} - \sigma_{max}/E$$

Therefore, the plastic strain associated with S_{max_i} is given in Eq. 5.

$$\varepsilon_{p_i} = (K_t S_{max_i})^2/E\sigma_{ys} - \sigma_{ys}/E \qquad (5)$$

If a residual stress existed prior to this plastic strain excursion, the plastic strain associated with that prior excursion is subtracted from Eq. 5 as shown in Eq. 6.

$$\varepsilon_{p_i} = (K_t S_{max_i})^2/E\sigma_{ys} - (\sigma_{ys} - \sigma_{res_{i-1}})^2/E\sigma_{ys} \qquad (6)$$

A similar calculation is made for plastic strains occurring during the minimum stress peak.

In the analysis developed by Potter [6] the residual stress cyclically relaxes toward zero or an equilibrium residual stress as shown in Fig. 4 according to Eq. 7.

$$\sigma_{res_{N=1,2,\ldots}} = (\sigma_{res_{N=1}} - \sigma_{res_{EQ}})\exp(N/N_{EP_i}\ln(0.1)) \qquad (7)$$

The N_{EP} term, the Equilibrium Period, is dependent upon the applied stress and the Residual Stress Relaxation Constant.

$$N_{EP_i} = (C1/(K_t S_{max_i}{}^{E1} \cdot K_t S_{mean_i}{}^{E2})) \qquad (8)$$

The Residual Stress Relaxation Constant, C1, has not yet been experimentally defined but should be a constant for a material.

<u>Module III - Cycle Counting Method</u>

After the local stress and plastic strain behavior is calculated, the local stress spectrum is Range Pair Counted using a computer program developed by Tischler. [11]

Module IV - Damage Calculation

Damage is calculated separately for the plastic strain excursions and the elastic stress spectrum. The damage is determined from the conventional $D = \sum \frac{n}{N}$ calculation. Damage from each of the plastic strain cycles is determined from the Coffin-Manson [12] form.

$$D_i = 1./N_{f_i} = 1./(\varepsilon_{p_i}/\varepsilon_f')^{1/c}$$

Damage from the elastic stress cycles is determined in a similar manner. The maximum and minimum local stress levels are sequentially compared to unnotched S-N data in a Modified Goodman Diagram format. Damage is summed, and failure of the coupon is defined as the event occurring when the summed damage equals unity.

SECTION III

INPUT DATA REQUIREMENTS

In general, each spectrum analyzed will require slightly different programming in order to get the load history into a usable format for the core program. The basic program requires a certain family of information before any analytical predictions can be made. Appendix I contains a program listing for the Sequence Accountable Fatigue Analysis. The subroutine CORE which accesses the subroutines having to do with RPCM, the Range Pair Counting Method, contains the basic analysis. Subroutine SAL reads the data input and then references subroutine CORE. The subroutine SAL shown is one in which a block of cycles is repeated with optional cycles. A list of the input data cards and the resulting analysis is given in Appendix II.

The specific data requirements are given below.

1. Stress-Strain Behavior - The stress-strain behavior is presumed to be elastic - perfectly plastic with the tensile yield stress being equal to the compressive yield stress. The yield stress value used is an average of the monotonic behavior generally being above the 0.2% yield value and below the engineering ultimate strength.

2. Residual Stress Relaxation - The residual stress relaxation behavior of Eq. 7 and 8 is characterized by C1, the Residual Stress Relaxation Constant and E1 and E2, the relaxation equation exponents. The Residual Stress Relaxation Constant, C1, has not yet been adequately determined. It should be a material property if the relaxation function

is correct and must be assumed. A reasonably accurate estimate of the Residual Stress Relaxation Constant for aluminum material falls in the range of 5-20 x 10^6 (cycles) $(Ksi)^2$. Further experimentation on the part of the analyst should develop a C1 usable for his set of conditions until actual measurement of residual stress relaxation behavior defines the relaxation function and constants. At present E1 and E2 are considered to be equal to 1.0.

3. Specimen Geometry - The elastic K_t value (if available) is entered into the analysis. If that value is not available then an estimate from some other method may be used. In certain cases, a value may be determined from a constant amplitude fatigue test of a similar structure by fitting several values of K_t to the analysis and determining the best correlation as is done with the K_f solution. Once a stress concentration factor, K_t, is determined for a specimen, that value is not changed from test-to-test of the same coupon configuration.

4. Load Multiplier - Different spectra are presented for analysis in different manners. Some data are presented in percent of maximum stress, others in terms of nominal stress, and others in terms of bending moment. The value of the load multiplier defines the nominal stress history.

5. Cumulative Damage Analysis - The damage from the range-paired elastic stress spectrum is determined by calculating a simple $\frac{n}{N}$ value for each level and accumulating the total. The N_{f_i} value is determined from unnotched coupon S-N data in the Modified Goodman Diagram format.

The program requires the input of four second order equations describing the maximum and minimum stress levels at lives of 10^4, 10^5, 10^6 and 10^7 cycles. The coefficients of the equations are derived by least square fitting the S-N data presented in the form of Eq. 9.

$$S_{max} = A(I)S_{min}^{2} + B(I)S_{min} + C(I) \tag{9}$$

The A, B, and C coefficients for several typical materials are presented in Appendix IV. The S-N data shown was derived from various sources but usually from the MIL-HDBK-5A [13]. The C coefficients correspond to the maximum stress level at zero to maximum applied stress conditions on the unnotched coupons.

The damage from the plastic strain cycles is determined using the Coffin-Manson relation to calculate the N_{f_i} value. The conventional plastic strain intercept at one reversal and the ε_p - life slope values are used in the analysis. Specific measured values from the literature are used when available and typical values when they are not available.

6. Analysis or Test Spectrum - The last information needed is the order and magnitude of application of the spectrum used in the test.

SECTION IV

OUTPUT OPTIONS

The Computer Program prints the following output in the process of the analysis.

1. Maximum and minimum applied stress and local stress response through the spectrum. Also printed out is the residual stress, equilibrium stress, applied cycles, and the equilibrium period.

2. The elastic local stress history as input into the Range Pair Subroutine and the resulting Range Paired spectrum.

3. The plastic strain occurrence during the spectrum and the damage associated with each strain reversal.

4. The accumulated damage associated with the plastic strains.

5. The Range Paired elastic stress spectrum and the damage associated with each level.

6. The accumulated damage associated with the current block of loading including the plastic strain damage and the total damage since the initiation of cycling.

At the option of the analyst, he can print out all the above items or only two. The IPRINT value controls what data is printed.

If IPRINT = 1, all six items are printed for each flight or block.

If IPRINT = 2, all items except 2. above are printed.

If IPRINT = 3, only items 4. and 6. above are printed.

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13. Metallic Materials and Elements for Aerospace Vehicle Structures, MIL-HDBK-5A, Department of Defense, Washington, D. C., Feb. 1966.

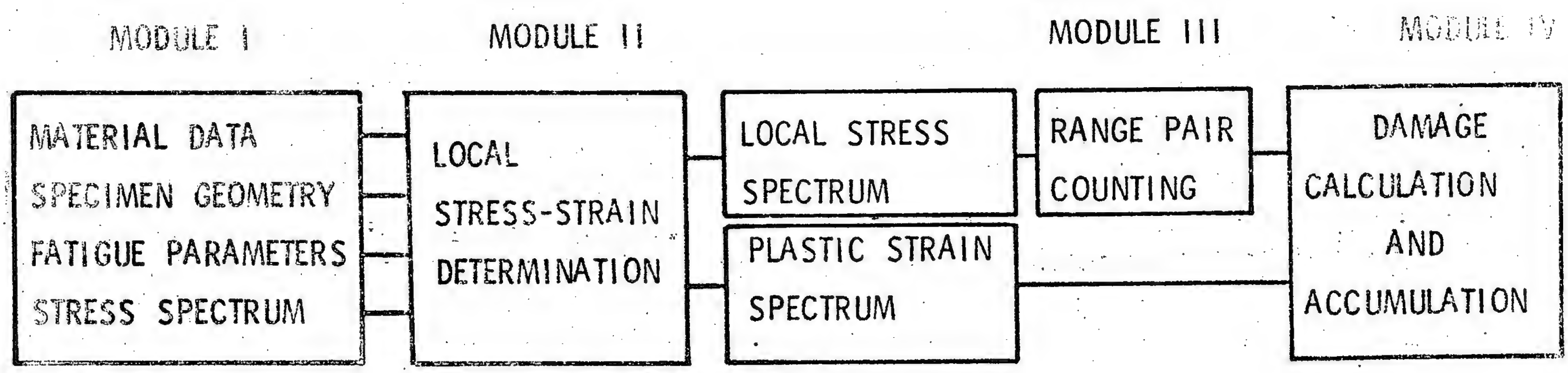

FIGURE 1. PROCEDURE USED IN THE SEQUENCE ACCOUNTABLE FATIGUE ANALYSIS

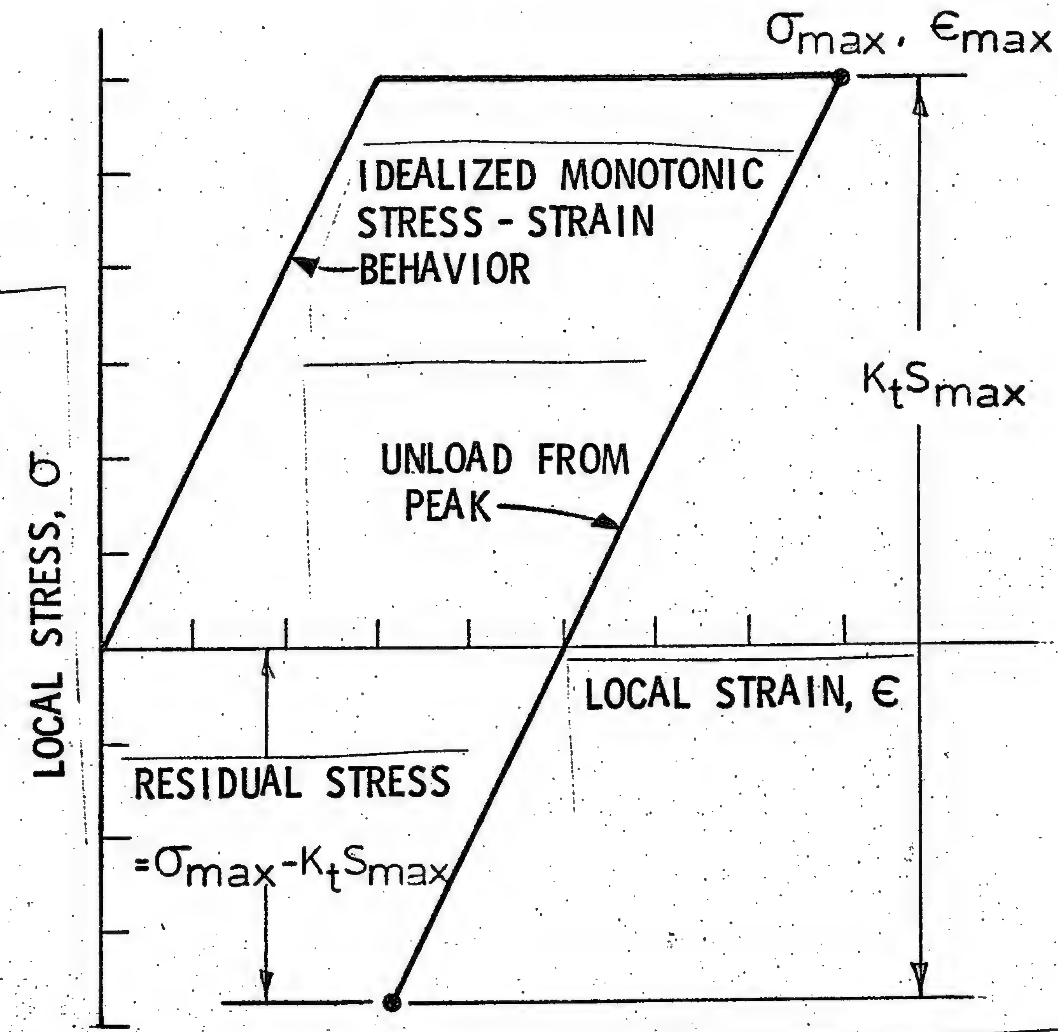

FIGURE 2. METHOD OF DETERMINING THE RESIDUAL STRESS FOLLOWING A PEAK LOAD

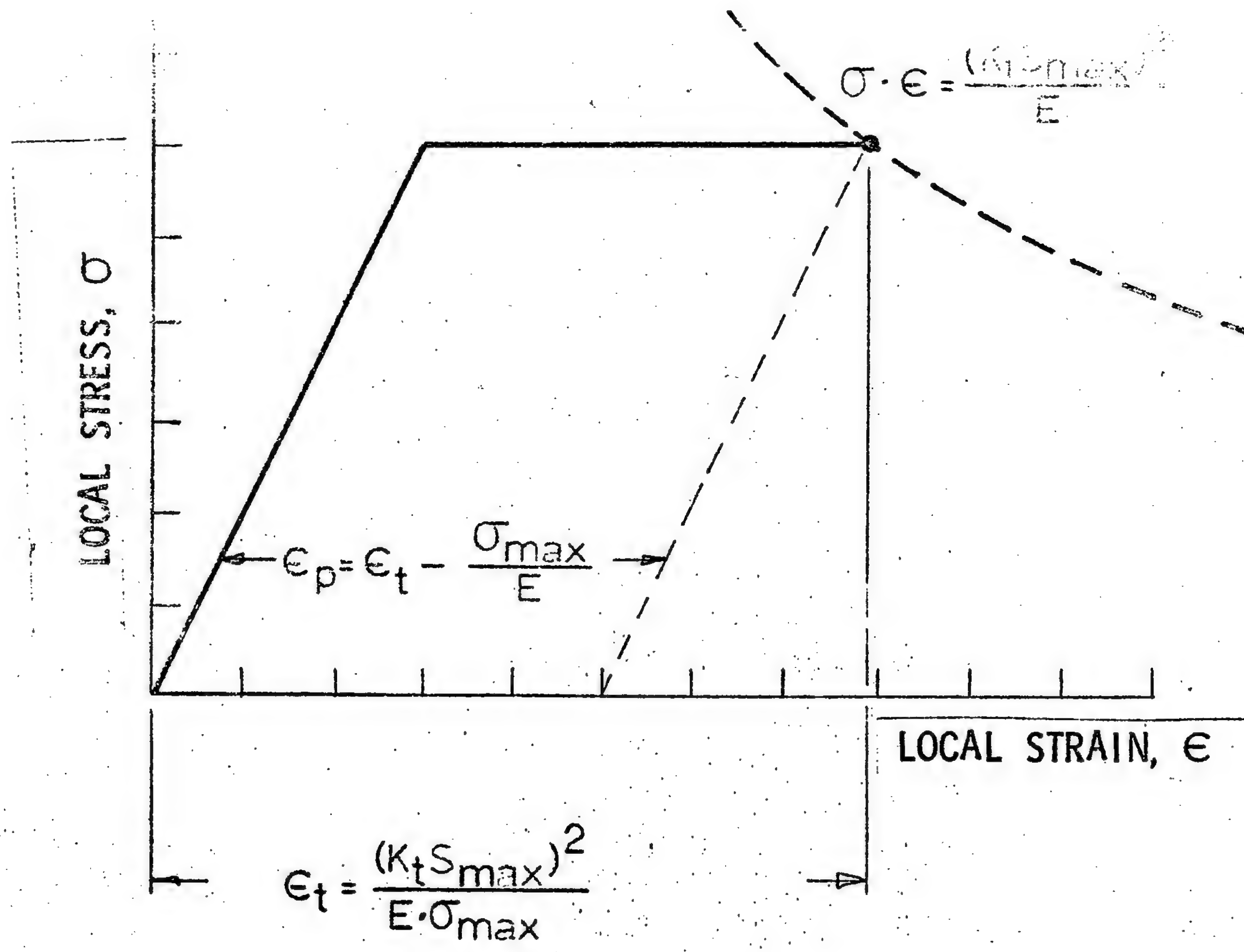

FIGURE 3. METHOD OF DETERMINING PLASTIC STRAIN LEVELS

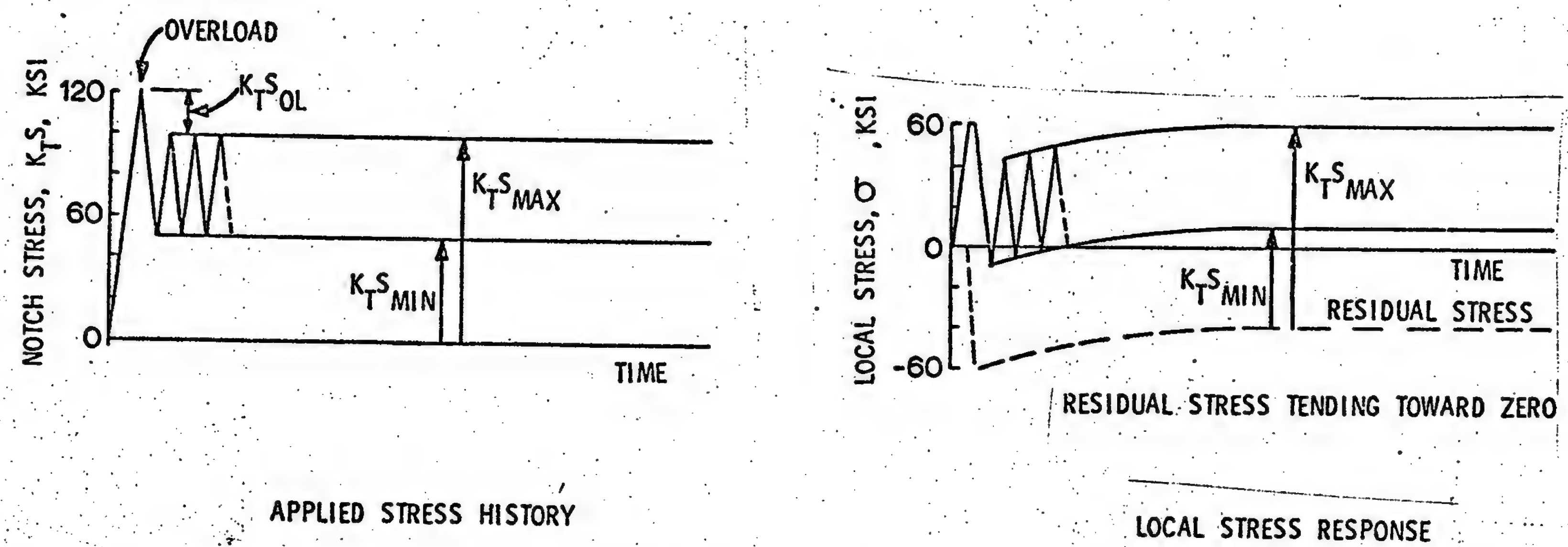

FIGURE 4. LOCAL STRESS RESPONSE FOR APPLIED CONSTANT AMPLITUDE LOADING WITH RESIDUAL STRESS RELAXATION

APPENDIX I

PROGRAM LIST


```
      PROGRAM SAL(INPUT,TAPE5=INPUT,OUTPUT,TAPE6=OUTPUT)
C
C     ****************************************************************
C
C                       MODULE I
C               INPUT ROUTINE FOR THE
C     SEQUENCE ACCOUNTABLE FATIGUE ANALYSIS
C
C     ****************************************************************
C
C          PROGRAM DEVELOPED BY  JOHN M. POTTER AND ROBERT A. NOBLE
C              OF THE AIR FORCE FLIGHT DYNAMICS LABORATORY
C                   MARCH 1973
C                ADDRESS: AFFDL/FBR
C                         WRIGHT-PATTERSON AFB,OHIO  45433
C                TELEPHONE  (513) 255-5194  OR  255-6106
C
C     INPUT
C
C
C     DATA CARD 1.     NDECK = THE NUMBER OF DATA DECKS TO BE RUN SEQUENTIALLY.
C                      IPRINT   THE VALUE CONTROLLING THE WRITE STATEMENTS
C                                  1  PERMITS MAXIMUM PRINTOUT
C                                  2  SUPPRESSES RAINFLOW PRINTING
C                                  3  MAXIMUM SUPPRESSION OF PRINTOUT
C                      IRPCM= THE VALUE CONTROLLING THE ENTRY INTO THE
C                             RANGE PAIR COUNTING SUBROUTINE
C                                  1  ENTER RANGE PAIR COUNTING SUBROUTINE
C                                  2  SKIP RANGE PAIR COUNTING SUBROUTINE
C                      FORMAT  3I4
C
C     EACH DATA DECK CONTAINS THE FOLLOWING CARDS --
C
C     CARD 1.       TEST IDENTIFYING INFORMATION
C                   FORMAT  8A8
C
C     CARD 2.       IM     = MATERIAL TYPE
C                   TYS    = TENSILE YIELD STRESS (KSI)
C                   EPSD   = LCF STRAIN INTERCEPT
C                   COFMAN = INVERSE OF COFFIN-MANSON SLOPE
C                   ELMOD=  MODULUS OF ELASTICITY  (KSI)
C                   FORMAT 2A8,3F18.5,F10.2
C
C     CARDS 3,...,6.  A(N)   N=4,7   (A,B,C ARE COEFFICIENTS OF SECOND
C                                    (ORDER LEAST SQUARE FIT OF S-N DATA.
C                     B(N)           (FOR CURVE OF 10**N CYCLES.)
C                     C(N)           (STMAX = A(N)*STMIN**2 + B(N)*STMIN + C(N))
C                     TITLE1         (TITLE1,TITLE2 IDENTIFIES THE       )
C                     TITLE2         (SOURCE OF THE S-N DATA             )
C                     N              (PUNCHED IN COLUMN 72. FOR INFO.)
C                     MATERIAL TYPE  (COLUMNS 73-80. FOR INFO ONLY.   )
C                     FORMAT 3F18.5,2A8
C
C     CARD 7.       C1               (CONSTANTS TO BE USED IN CALCULA-  )
```

```
C                   E1                (TION OF EQUILIBRIUM PERIOD, ENEP.)
C                   E2                (ENEP=C1/(KTSMAX**E1*KTSMEAN**E2) )
C                   FORMAT  3F18.5
C
C      CARD 8.      AKT = STRESS CONCENTRATION FACTOR USED THE FIRST
C                         TIME THROUGH THE PROGRAM
C                   ZKT = STRESS CONCENTRATION FACTOR USED THE LAST
C                         TIME THROUGH THE PROGRAM
C                   DELAKT = STEP CHANGE IN KT BETWEEN RUNS
C                   FORMAT  3F18.5
C
C      CARD 9.      NBLOCK = NUMBER OF BLOCKS (NO. OF TIMES TO REPEAT LIST
C                                                      OF LOADS)
C                   NLEVEL = NUMBER OF LOADS
C                   NTYPE  = NUMBER OF TYPES OF LOADS
C                   FORMAT  3I10
C
C      CARD 10.     TLL = LIMIT LOAD
C                   FORMAT  F18.5
C
C      CARDS 11,...,NLEVEL + 10.
C                   ISTEP(K) = K = THE KTH STEP      (K=1,NLEVEL)
C                   ITYPE(K) = THE IDENTIFYING TYPE OF THE KTH LOAD
C                   STMIN(K) = THE KTH MINIMUM (DECIMAL FRACTION OF TLL)
C                   STMAX(K) = THE KTH MAXIMUM (DECIMAL FRACTION OF TLL)
C                   ENN(K)   = NUMBER OF CYCLES AT THE KTH LOAD
C                   FORMAT  2(I4,2X),3(F18.5,1X)
C
C      CARDS NLEVEL + 11,...,NLEVEL + 10 + NBLOCK.
C                   IBLOCK(JJ) = JJ = THE JJTH BLOCK       (JJ=1,NBLOCK)
C                   NN(JJ,1)   = TYPE OF LOAD INCLUDED IN JJTH BLOCK
C                   NN(JJ,2)   =          (THERE WILL BE ONE NN VALUE      )
C                   NN(JJ, )   =          (ON THE CARD FOR EACH DIFFERENT )
C                   FORMAT  9I5           (TYPE OF LOAD INCLUDED IN THE    )
C                                         (JJTH BLOCK                      )
C
      COMMON/MSAL/RNCYC(200),KPMAX,IPRINT
      DIMENSION RTMIN(200),RTMAX(200),RNN(200),ITYPE(200)
      COMMON/MCOR1/NLEVEL,IRPCM,IPLOT,ELMOD,TYS,EPSD,COFMAN,C1,E2,E1,
     *RES(200),AKT,SUMENN,SUMNC
      COMMON/MCOR2/STMIN(200),STMAX(200),ENN(200),A(10),B(10),C(10),
     *R(10),ISTEP(200),NN(200,10),IBLOCK(200)
      READ(5,4) NDECK,IPRINT,IRPCM
    4  FORMAT(3I4)
      WRITE(6,3) NDECK
    3 FORMAT(1H1,I4,32H DATA DECKS ARE TO BE PROCESSED.)
      IF(IRPCM.GE.2)GO TO 6
      WRITE(6,11)
      GO TO 13
    6 WRITE(6,7)
    7 FORMAT(25H NO COUNTING METHODS USED)
   13 CONTINUE
      DO 595 LMN = 1,NDECK
      WRITE(6,5)
    5 FORMAT(40H SEQUENCE ACCOUNTABLE FATIGUE EVALUATION)
```

```
      READ(5,9)T1,T2,T3,T4,T5,T6,T7,T8
    9 FORMAT(8A8)
      WRITE(6,8)T1,T2,T3,T4,T5,T6,T7,T8
    8 FORMAT(16H1SPECTRUM FROM   ,8A8)
C
C          INPUT OF DATA PECULIAR TO A MATERIAL
C
      READ(5,10)TM1,TM2,TYS,EPSD,COFMAN,ELMOD
   10 FORMAT(2A8,3F18.5,F10.2)
      WRITE(6,12)TM1,TM2,TYS,EPSD,COFMAN,ELMOD
   12 FORMAT(18H MATERIAL TYPE -- ,2A8,//30H TENSILE YIELD STRESS (KSI)
     *--,F18.5,//23H LCF STRAIN INTERCEPT =,F18.5,//31H INVERSE OF COFFI
     *N-MANSON SLOPE,F18.5,//18H ELASTIC MODULUS =,F18.5)
      READ(5,14) (A(N),B(N),C(N),TITLE1,TITLE2,N=4,7)
   14 FORMAT(3F18.5,2A8)
      WRITE(6,16)
   16 FORMAT(58H0COEFFICIENTS OF SECOND ORDER LEAST SQUARE FIT OF S-N DA
     *TA)
      WRITE(6,18)
   18 FORMAT(44H        SMAX = A(I)*SMIN**2 + B(I)*SMIN + C(I))
      WRITE(6,20)
   20 FORMAT(5X,5H LIFE,10X,5H A(I),14X,5H B(I),14X,5H C(I))
      WRITE(6,22)(N,A(N),B(N),C(N),N=4,7)
   22 FORMAT(8H    10**,I2,3F18.5)
      WRITE(6,56) TITLE1,TITLE2
   56 FORMAT(39H0UNNOTCHED COUPON S-N DATA DERIVED FROM/28H INFORMATION
     *SUPPLIED FROM   ,2A8)
      READ(5,14) C1,E1,E2
      WRITE(6,24)
   24 FORMAT(36H0RESIDUAL STRESS RELAXATION FUNCTION)
      WRITE(6,26)
   26 FORMAT(/42H        ENEP = C1/(KTSMAX**E1 * KTSMEAN**E2)/)
      WRITE(6,28) C1,E1,E2
   28 FORMAT(13H+WHERE   C1 =,E15.8,9H ,   E1 =,F10.3,10H AND  E2 =,F10.
     *3)
C
C
C
C          INPUT OF DATA PECULIAR TO A SEQUENCE
C
C
      READ(5,65)AKT
   65 FORMAT(F18.5)
      READ(5,32) NBLOCK,JLEVEL,NTYPE
   32 FORMAT(3I10)
      WRITE(6,34) NBLOCK,JLEVEL
   34 FORMAT(// I10,23H TIMES THROUGH BLOCK OF,I10,6H LOADS)
      READ(5,35) TLL
   35 FORMAT(F18.5)
      WRITE(6,33) TLL
   33 FORMAT(/ 5X,13H LOAD LIMIT =,F18.5)
      READ(5,36)(ISTEP(K),ITYPE(K),RTMIN(K),RTMAX(K),RNN(K),K=1,JLEVEL)
   36 FORMAT(I4,2X,I4,2X,F18.5,1X,F18.5,1X,F18.5,1X)
      WRITE(6,38)
   38 FORMAT(//11H STEP  TYPE,10X,6H STMIN,14X,6H STMAX,15X,4H ENN)
```

```
      WRITE(6,36)(ISTEP(K),ITYPE(K),RTMIN(K),RTMAX(K),RNN(K),K=1,JLEVEL)
      WRITE(6,39)
   39 FORMAT(//47H BLOCK  TYPE TYPE TYPE TYPE TYPE TYPE TYPE TYPE/)
      DO 42 JJ=1,NBLOCK
      READ(5,40) IBLOCK(JJ),(NN(JJ,KK),KK=1,NTYPE)
      WRITE(6,40) IBLOCK(JJ),(NN(JJ,KK),KK=1,NTYPE)
   40 FORMAT(9I5)
   42 CONTINUE
      SUMENN=0.
      SUMN3=0.
      RES(1)=0.
       WRITE(6,8)T1,T2,T3,T4,T5,T6,T7,T8
      WRITE(6,51) (AKT)
   51 FORMAT(7H AKT = ,(F6.2))
        WRITE(6,55)C1
   55 FORMAT(//24H RELAXATION CONSTANT C1=,F15.2)
       IF(IRPCM.GE.2)GO TO 59
      WRITE(6,11)
   11 FORMAT(56HOSPECTRUM SUBJECTED TO THE RANGE-PAIR COUNTING TECHNIQUE)
     *)
   59 CONTINUE
      DO 1002 KFL=1,NBLOCK
       JJJ=1
      DO 60 J=1,JLEVEL
      DO 70 KK=1,NTYPE
       IF(NN(KFL,KK).EQ.0) GO TO 60
       IF(ITYPE(J).EQ.NN(KFL,KK))GO TO 150
   70 CONTINUE
  150  STMIN(JJJ)=RTMIN(J)*TLL
       STMAX(JJJ)=RTMAX(J)*TLL
       ENN(JJJ)=RNN(J)
      JJJ=JJJ+1
   60 CONTINUE
       NLEVEL=JJJ-1
      CALL CORE(KFL)
       IPRINT=2
 1002 CONTINUE
  597 CONTINUE
  595 CONTINUE
  596 CONTINUE
  580 STOP
      END
```

```
      SUBROUTINE CORE(KFL)                                              CORE       2
C     ******************************************************************CORE       3
C                                                                       CORE       4
C                         CORE PROGRAM OF                               CORE       5
C              THE SEQUENCE ACCOUNTABLE FATIGUE ANALYSIS                CORE       6
C                                                                       CORE       7
C                                                                       CORE       8
C                           MODULE II                                   STD        1
C                                                                       CORE      10
C                LOCAL STRESS AND STRAIN DETERMINATION                  CORE      11
C                                                                       CORE      12
C     ******************************************************************CORE      13
C                                                                       CORE      14
      COMMON/MDEC1/SIGMAX(200),SIGMIN(200)                              CORE      15
      COMMON/MSAL/RNCYC(200),KPMAX,IPRINT                               CORE      16
      DIMENSION PLSTRA(200), FN(200),AVSGMX(200),AVSGMN(200),EX(200),   CORE      17
     *ENNCYC(200),ASX(200),ASN(200),ASE(200)                            CORE      18
      COMMON/MCOR1/NLEVEL,IRPCM,IPLOT,ELMOD,TYS,EPSO,COEMAN,C1,E2,E1,   CORE      19
     *RES(200),AKT,SUMENN,SUMNC                                         CORE      20
      COMMON/MCOR2/STMIN(200),STMAX(200),ENN(200),A(10),B(10),C(10),    CORE      21
     *R(10),ISTEP(200),NN(200,10),IBLOCK(200)                           CORE      22
      JJ=KFL                                                            CORE      23
      IF(JJ.GT.3)IPRINT=3                                               CORE      24
      IRAIN=1                                                           CORE      25
      WRITE(6,54)JJ                                                     CORE      26
   54 FORMAT(20H FLIGHT OR BLOCK NO.,I5)                                CORE      27
      IF(IPRINT.GE.3) GO TO 51                                          CORE      28
      WRITE(6,62)                                                       CORE      29
   62 FORMAT(66H STMAX    STMIN    SIGMAX  SIGMIN    RES     EORES     ENN  CORE      30
     *      NEP)                                                        CORE      31
   51 CONTINUE                                                          CORE      32
C                                                                       CORE      33
C                                                                       CORE      34
      KPLOT=1                                                           CORE      35
  148 DO 570 J=1,NLEVEL                                                 CORE      36
  149 I=J+1                                                             CORE      37
      PLSTRA(J)=0.                                                      CORE      38
C                                                                       CORE      39
C       DETERMINE SEQUENCE  ACCOUNTABLE RESIDUAL STRESS AND CORRESPONDING CORE    40
C         PLASTIC STRAIN                                                CORE      41
C                                                                       CORE      42
  150 ASMAX=AKT*STMAX(J)                                                CORE      43
      ASMIN=AKT*STMIN(J)                                                CORE      44
       ASX(KPLOT)=ASMAX                                                 CORE      45
      ASN(KPLOT)=ASMIN                                                  CORE      46
      ASE(KPLOT)=ENN(J)                                                 CORE      47
      KPLOT=KPLOT+1                                                     CORE      48
      ASMEAN=(ASMAX+ASMIN)/2.                                           CORE      49
      JA=0                                                              CORE      50
  170 IF(RES(I-1)+ASMIN+TYS) 190,190,200                                CORE      51
  190 JA=1                                                              CORE      52
      AAA=RES(I-1)+ASMIN                                                CORE      53
      PLSTRA(J)=     -1.*(AAA/ELMOD)*(1.+AAA/TYS)                       CORE      54
  200 JB=0                                                              CORE      55
  202 IF(RES(I-1)+ASMAX-TYS) 220,210,210                                CORE      56
```

```
  210   JB=-1
        AAA=ASMAX
        BBB=TYS-RES(I-1)
        IF(BBB.GE.TYS) GO TO 214
  212   BBB=0.
  214   PLSTRA(J)=    AAA*AAA/(ELMOD*TYS)-BBB*BBB/(ELMOD*TYS)
  220   IF(JA+JB) 230,250,240
  230   RES(I)=TYS-ASMAX
        GO TO 290
  240   RES(I)=-TYS-ASMIN
        GO TO 290
  250   IF(JA) 260,260,270
  260   RES(I)=RES(I-1)
        GO TO 290
  270   RES(I)=-ASMEAN
  290   SIGMAX(IRAIN)=RES(I)+ASMAX
        SIGMIN(IRAIN)=RES(I)+ASMIN
        RNCYC(IRAIN)=ENN(J)
        IF(ASMAX.LE.TYS) GO TO 410
  400   EQRES=-ASMAX+TYS
        GO TO 440
  410   IF(ASMIN.GE.-TYS) GO TO 430
  420   EQRES=-ASMIN-TYS
        GO TO 440
  430   EQRES=0.
  440   DIF=RES(I)-EQRES
C
C         CALCULATE RELAXATION FUNCTION
C
        ABMAX=ABS(ASMAX)
        ABMIN=ABS(ASMIN)
        ABMEAN=ABS(ASMEAN)
         IF(ABMAX.LT.1.)ABMAX=1.
         IF(ABMEAN.LT.1.)ABMEAN=0.5
        IF(ABMIN-ABMAX) 444,444,442
  442   ABM=ABMIN
        GO TO 446
  444   ABM=ABMAX
  446   ENEP=C1/(ABM**E1*ABMEAN**E2)
        IF(IPRINT.GE.3)GO TO 351
        WRITE(6,350) STMAX(J),STMIN(J),SIGMAX(IRAIN),SIGMIN(IRAIN),
       *RES(I),EQRES,ENN(J),ENEP,J
  350    FORMAT(6(F7.2,1X),F6.2,1X,E15.8,5X,I6)
  351     CONTINUE
C
C         CALCULATE RESIDUAL STRESS RELAXATION
C
        IRAIN=IRAIN+1
        ABDIF=ABS(DIF)
        GO TO 350
        GO TO 550
  360   IF(ABDIF.LT.5.) GO TO 560
  370   IF(1000.*ENN(J).LT.ENEP) GO TO 560
         IF(ENN(J).LE.10.) GO TO 560
  380   NFLAG=0
```

21

```
      NFLAG2=10                                                           CORE   112
      IRAIN=IRAIN-1                                                       CORE   113
      DUMMY=ENN(J)                                                        CORE   114
  450 IF(DUMMY-ENEP) 470,460,460                                          CORE   115
  460 DUMMY=DUMMY/2.                                                      CORE   116
      NFLAG=NFLAG+1                                                       CORE   117
      GO TO 450                                                           CORE   118
  470 CYCINT=DUMMY/10.                                                    CORE   119
      DO 530 K=1,10                                                       CORE   120
      DECK=FLOAT(K)                                                       CORE   121
      EN(K)=CYCINT*DECK                                                   CORE   122
      IF(K.EQ.1) GO TO 490                                                CORE   123
  480 EX(K)=EXP(-2.303*EN(K-1)/ENEP)+EXP(-2.303*EN(K)/ENEP)               CORE   124
      GO TO 500                                                           CORE   125
  490 EX(K)=1.+EXP(-2.303*EN(K)/ENEP)                                     CORE   126
  500 CONTINUE                                                            CORE   127
      IF(NFLAG.EQ.0) GO TO 530                                            CORE   128
  510 NFLAG2=NFLAG+10                                                     CORE   129
      DO 520 K=11,NFLAG2                                                  CORE   130
      EN(K)=2.*DUMMY                                                      CORE   131
      EX(K)=EXP(-2.303*EN(K-1)/ENEP)+EXP(-2.303*EN(K)/ENEP)               CORE   132
      DUMMY=2.*DUMMY                                                      CORE   133
  520 CONTINUE                                                            CORE   134
  530 DO 559 K=1,NFLAG2                                                   CORE   135
      AVSGMX(K)=ASMAX+EQRES+DIF*EX(K)/2.                                  CORE   136
      AVSGMN(K)=AVSGMX(K)-ASMAX+ASMIN                                     CORE   137
      SIGMIN(IRAIN)=AVSGMN(K)                                             CORE   138
      SIGMAX(IRAIN)=AVSGMX(K)                                             CORE   139
      RNCYC(IRAIN)=EN(K)                                                  CORE   140
  545 IF(K.EQ.1) GO TO 540                                                CORE   141
  539 RNCYC(IRAIN)=RNCYC(IRAIN)-EN(K-1)                                   CORE   142
  540 IF(IPRINT.GE.3)GO TO 551                                            CORE   143
      WRITE(6,550) SIGMAX(IRAIN),SIGMIN(IRAIN),EN(K),RNCYC(IRAIN)         CORE   144
  550 FORMAT(16X,2(F7.2,1X),16X,F6.2,17X,F15.8)                           CORE   145
  551  CONTINUE                                                           CORE   146
      IRAIN=IRAIN+1                                                       CORE   147
  559  CONTINUE                                                           CORE   148
  560 CONTINUE                                                            CORE   149
      RES(I)=EQRES+DIF*EXP(-2.303*ENN(J)/ENEP)                            CORE   150
  570 CONTINUE                                                            CORE   151
  569 RES(1)=RES(J)                                                       CORE   152
      IN=IRAIN-1                                                          CORE   153
C                                                                         CORE   154
C     ************************************************************************ CORE   155
C                                                                         CORE   156
C                             MODULE III                                  STD      2
C                      CYCLE COUNTING TECHNIQUE                           CORE   158
C                                                                         CORE   159
C     ************************************************************************ CORE   160
C                                                                         CORE   161
C        CALL SUBROUTINE TO RANGE PAIR COUNT SPECTRUM                     CORE   162
C                                                                         CORE   163
       IF(IRPCM.GT.1)GO TO 591                                            CORE   164
      CALL RPCM(IN)                                                       CORE   165
      GO TO 592                                                           CORE   166
```

```
      591  CONTINUE                                                        CORE   167
           KPMAX=IN                                                        CORE   168
      592  CONTINUE                                                        CORE   169
C                                                                          CORE   170
C          *************************************************************** CORE   171
C                                                                          CORE   172
C                              MODULE IV                                   STD      3
C                   DAMAGE ACCUMULATION CALCULATION                        CORE   174
C                                                                          CORE   175
C          *************************************************************** CORE   176
C                                                                          CORE   177
           IF(IPRINT.GE.3)GO TO 552                                        CORE   178
           WRITE(6,53)                                                     CORE   179
       53  FORMAT(//60H LOCAL STRESSES AND PLASTIC STRAINS W/RESULTING FATIGU CORE   180
          *E LIFE//10X,4HSTEP,10X,14HPLASTIC STRAIN,10X,10HMAX OR MIN,15X,6HD CORE   181
          *AMAGE)                                                          CORE   182
      552    CONTINUE                                                      CORE   183
C                                                                          CORE   184
C            CALCULATE DAMAGE FROM PLASTIC STRAIN CYCLES                   CORE   185
C                                                                          CORE   186
           SUMDEL=0.                                                       CORE   187
           DO 531 JKL=1,NLEVEL                                             CORE   188
           AA=1.                                                           CORE   189
           IF(PLSTRA(JKL)) 532,531,533                                     CORE   190
      532  AA=-1.                                                          CORE   191
      533  PLSTRA(JKL)=AA*PLSTRA(JKL)                                      CORE   192
           CYCLES=(PLSTRA(JKL)/EPSD)**COFMAN                               CORE   193
           DAM=1./CYCLES                                                   CORE   194
           SUMNC=SUMNC+DAM                                                 CORE   195
           SUMDEL=SUMDEL+DAM                                               CORE   196
           IF(IPRINT.GE.3) GO TO 531                                       CORE   197
           IF (AA) 535,535,537                                             CORE   198
      535  WRITE(6,199)JKL,PLSTRA(JKL),DAM                                 CORE   199
      199  FORMAT(10X,I4,12X,F10.5,15X,3HMIN,15X,E14.6)                    CORE   200
            GO TO 531                                                      CORE   201
      537  WRITE(6,219)JKL,PLSTRA(JKL),DAM                                 CORE   202
      219  FORMAT(10X,I4,12X,F10.5,15X,3HMAX,15X,E14.6)                    CORE   203
      531  CONTINUE                                                        CORE   204
           WRITE(6,541) SUMDEL                                             CORE   205
      541  FORMAT(59X,29H DAMAGE FROM PLASTIC STRAINS=,E15.8)              CORE   206
           IF(IPRINT.GE.3) GO TO 536                                       CORE   207
           WRITE(6,13)                                                     CORE   208
       13  FORMAT(/16X,15H SIGMAX  SIGMIN,18X,6H RNCYC,20X,25H CYCLES      CORE   209
          *    ENN/CYC)                                                    CORE   210
      536  CONTINUE                                                        CORE   211
C                                                                          CORE   212
C            CALCULATE ELASTIC CYCLE DAMAGE FROM LEAST SQUARE FITTED S-N DATA CORE   213
C                (MODIFIED GOODMAN DIAGRAM FORMAT)                         CORE   214
C                                                                          CORE   215
           DO 600 JKL=1,KPMAX                                              CORE   216
      534  TTYS=TYS/5.                                                     CORE   217
           X=SIGMIN(JKL)                                                   CORE   218
           Y=SIGMAX(JKL)                                                   CORE   219
           IF(Y-X.LT.1.6*TYS) GO TO 310                                    CORE   220
           CYCLES=10.**4.                                                  CORE   221
```

```
      GO TO 340
310   IF(Y.GE.TTYS) GO TO 320
347   CYCLES=10.**9.
       GO TO 340
320   N=4
      DO 330 M=1,4
      R(N)=A(N)*X**2+B(N)*X+C(N)-Y
      N=N+1
330   CONTINUE
332   IF(R(7)*R(4)) 339,338,334
334   ABR7=ABS(R(7))
      ABR4=ABS(R(4))
      IF(ABR7.LE.ABR4 ) GO TO 335
335   EXPO=4.+R(4)/(R(4)-R(5))
      GO TO 339
336   EXPO=7.+R(7)/(R(6)-R(7))
      GO TO 339
338   SUMR=R(4)+R(5)+R(6)+R(7)
      SUMR2=R(4)**2+R(5)**2+R(6)**2+R(7)**2
      SUMR3=R(4)**3+R(5)**3+R(6)**3+R(7)**3
      SUMR4=R(4)**4+R(5)**4+R(6)**4+R(7)**4
      SUMRN=4.*R(4)+5.*R(5)+6.*R(6)+7.*R(7)
      SUMR2N=4.*R(4)**2+5.*R(5)**2+6.*R(6)**2+7.*R(7)**2
      DEL1=4.*SUMR2*SUMR4-4.*SUMR3**2
      DEL2=SUMR*SUMR2*SUMR3-SUMR4*SUMR**2
      DEL3=SUMR*SUMR2*SUMR3-SUMR2**3
      DD1=22.*SUMR2*SUMR4-22.*SUMR3**2
      DD2=SUMR2*SUMR3*SUMRN-SUMR*SUMR4*SUMRN
      DD3=SUMR*SUMR3*SUMR2N-SUMR2N*SUMR2**2
      EXPO=(DD1+DD2+DD3)/(DEL1+DEL2+DEL3)
339   CYCLES=10.**EXPO
      IF(EXPO.LE.4.)CYCLES=10.**4.
340   ENNCYC(JKL)=RNCYC(JKL)/CYCLES
      SUMNC=SUMNC+ENNCYC(JKL)
       SUMDEL=SUMDEL+ENNCYC(JKL)
      IF(IPRINT.GE.3)GO TO 600
      WRITE(6,599) Y,X,RNCYC(JKL),CYCLES,ENNCYC(JKL)
599    FORMAT(16X,2(F7.2,1X),16X,F6.0,17X,2(E15.8,1X))
600   CONTINUE
      WRITE(6,593)SUMDEL
593   FORMAT(/69X,21H DAMAGE PER THIS SET=,E15.8)
      WRITE(6,575) SUMNC
575   FORMAT(/69X,18H  TOTAL ENN/CYC =,E15.8)
      END
```

```
      SUBROUTINE RPCM(NPKS)                                             CORE   266
C                                                                       CORE   267
C     THIS PROGRAM EMPLOYS THE RANGE PAIR CYCLE COUNTING METHOD TO GENER CORE  268
C     ANALYSIS SPECTRUM FROM A GIVEN LOAD SPECTRUM                      CORE   269
C                                                                       CORE   270
C                                                                       CORE   271
C                            PROGRAM ARRAYS                             CORE   272
C                   (INFORMATION NEEDED TO CHANGE DIMENSIONS)           CORE   273
C                                                                       CORE   274
C     ARRAY NAME          DEFINITION                     DIMENSION      CORE   275
C       SIGMAX      PEAKS OF THE INPUT LOAD SPECTRUM     NPKS + KK      CORE   276
C              KK = THE NUMBER OF ADDITIONAL CYCLES (EXCLUDING INPUT CYCL CORE 277
C                   WHICH THE PROGRAM WILL GENERATE                     CORE   278
C       SIGMIN      VALLEYS OF THE INPUT LOAD SPECTRUM   NPKS + KK      CORE   279
C       RNCYC       K COUNTERS OF THE PEAKS AND VALLEYS  NPKS + KK      CORE   280
C       NSTEP       STEP NUMBERS OF THE INPUT SPECTRUM   NPKS + KK      CORE   281
C       RES         RESIDUE SPECTRUM                      2*NPKS        CORE   282
C       INDEX       STEP NUMBERS OF ELEMENTS IN RES       2*NPKS        CORE   283
C       CYCLE       RANGE PAIR COUNTED CYCLES            NPKS + KK      CORE   284
C       RNECYC      K COUNTERS OF THE CYCLES OF THE      NPKS + KK      CORE   285
C                   UNSORTED ANALYSIS SPECTRUM                          CORE   286
C       NNSTEP      STEP NUMBERS OF ELEMENTS OF THE      NPKS + KK      CORE   287
C                   UNSORTED ANALYSIS SPECTRUM                          CORE   288
C       ISAVE       VALUES OF NSTEP(J) SUCH THAT RNCYC(J)     99        CORE   289
C                   IS < 1.0 AND VALUES OF NSTEP(J) SUCH                CORE   290
C                   THAT SIGMAX(J-1) = SIGMAX(J) AND                    CORE   291
C                   SIGMIN(J-1) = SIGMIN(J)                             CORE   292
C                                                                       CORE   293
C                                                                       CORE   294
      COMMON/MSAL/RNCYC(200),KPMAX,IPRINT                               CORE   295
      COMMON/MDEC1/SIGMAX(200),SIGMIN(200)                              CORE   296
      COMMON/MDEC2/NSTEP(900),LR,KMAX,KMIN,K31                          CORE   297
      COMMON/MDECP/RES(1400),INDEX(1400),IND1,IND2,IND3,IND4,KIND       CORE   298
      COMMON/MCYG/CYCLE(900,2),RNECYC(900),NNSTEP(900)                  CORE   299
      COMMON/MCGDE/L,LIND                                               CORE   300
      DIMENSION ISAVE(99),TITLE(8)                                      CORE   301
 9999 NPUNCH = 0                                                        CORE   302
      DO 8000 I = 1,NPKS                                                CORE   303
 8000 NSTEP(I) = I                                                      CORE   304
      IF(IPRINT.GE.2)GO TO 103                                          CORE   305
      WRITE(6,20) NPKS                                                  CORE   306
   20 FORMAT(1H0,60HTHE NUMBER OF PEAKS OR VALLEYS IN THE INPUT LOAD SPE CORE  307
     1CTRUM = ,I5//)                                                    CORE   308
      WRITE(6,22)                                                       CORE   309
   22 FORMAT(60X,5HSIGMA/31X,4HSTEP,13X,7HMAXIMUM,16X,7HMINIMUM,13X,     CORE   310
     1        9HCOUNTER K/)                                             CORE   311
      WRITE(6,25) (NSTEP(I),SIGMAX(I),SIGMIN(I),RNCYC(I), I = 1,NPKS)   CORE   312
   25 FORMAT(29X,I5,10X,E13.6,10X,E13.6,10X,F10.5)                      CORE   313
  103  CONTINUE                                                         CORE   314
C                                                                       CORE   315
C     SORT THROUGH THE LOAD SPECTRUM - PULL OUT THOSE PEAKS AND VALLEYS CORE   316
C     COUNTER K IS LESS THAN 1.0                                        CORE   317
C                                                                       CORE   318
      J = 1                                                             CORE   319
      L = 0                                                             CORE   320
```

```
      NRFS = 1
      RCYNO = 100
      JMAX = 0
      DO 100 I = 1,NPKS
      IF (RNCYC(I) .GE. 1.0) GO TO 100
      X1 = SIGMAX(I)
      X2 = SIGMIN(I)
      CALL CYCGEN(X1,X2  ,RNCYC(I),NSTEP(I))
      ISAVE(J) = I
      J = J + 1
  100 CONTINUE
      JMAX = J - 1
      NPKSN = NPKS - JMAX
      IF (JMAX .EQ. 0) GO TO 200
      WRITE(6,23) (ISAVE(K), K = 1,JMAX)
      IF(IPRINT.GE.2)GO TO 101
   23 FORMAT(1H0,33HSTEP NUMBERS OF THOSE PEAKS AND VALLEYS IN THE LOAD
     1SPECTRUM WHOSE COUNTER K IS LESS THAN 1.0//(17I7))
  101 CONTINUE
      DO 110 J = 1,JMAX
      I = ISAVE(J) - (J-1)
      NPKN = NPKS - J
      IF (I .EQ. NPKN) GO TO 110
      DO 115 II = I,NPKN
      SIGMAX(II) = SIGMAX(II+1)
      SIGMIN(II) = SIGMIN(II+1)
      NSTEP(II) = NSTEP(II+1)
      RNCYC(II) = RNCYC(II+1)
  115 CONTINUE
  110 CONTINUE
  200 CONTINUE
C
C     SORT THROUGH THE LOAD SPECTRUM DATA - COMBINE STEPS WITH IDENTICAL
C     AND VALLEYS WHICH OCCUR CONSECUTIVELY
C
      J = 1
      DO 300 I = 2,NPKSN
      IF (SIGMAX(I) .NE. SIGMAX(I-1)) GO TO 300
      IF (SIGMIN(I) .NE. SIGMIN(I-1)) GO TO 300
      ISAVE(J) = I
      RNCYC(I-1) = RNCYC(I-1) + RNCYC(I)
      J = J + 1
  300 CONTINUE
      IF (J .EQ. 1) GO TO 6000
      JMAS = J - 1
      DO 311 J = 1,JMAS
      I = ISAVE(J) - (J-1)
      NPKN = NPKSN - J
      IF (I .EQ. NPKN) GO TO 311
      DO 316 II = I,NPKN
      SIGMAX(II) = SIGMAX(II+1)
      SIGMIN(II) = SIGMIN(II+1)
      NSTEP(II) = NSTEP(II+1)
      RNCYC(II) = RNCYC(II+1)
  316 CONTINUE
```

```
  311 CONTINUE                                                  CORE    376
      NPKSN = NPKSN - JMAS                                      CORE    377
C                                                               CORE    378
C     RANGE PAIR COUNT THE ADJUSTED LOAD SPECTRUM               CORE    379
C                                                               CORE    380
 6000 I = 1                                                     CORE    381
      KB = 0                                                    CORE    382
      L = JMAX                                                  CORE    383
      KMIN = 0                                                  CORE    384
      KMAX = 0                                                  CORE    385
      LR = 0                                                    CORE    386
      K31 = 0                                                   CORE    387
    1 IF (RNCYC(I) .GT. 1.0) GO TO 400                          CORE    388
      IF (KB .NE. 0) GO TO 5                                    CORE    389
      X1 = SIGMAX(I)                                            CORE    390
      X2 = SIGMIN(I)                                            CORE    391
      IND1 = NSTEP(I)                                           CORE    392
      IND2 = IND1                                               CORE    393
      I = I + 1                                                 CORE    394
      KB = 1                                                    CORE    395
      GO TO 1                                                   CORE    396
    5 X3 = SIGMAX(I)                                            CORE    397
      X4 = SIGMIN(I)                                            CORE    398
      IND3 = NSTEP(I)                                           CORE    399
      IND4 = IND3                                               CORE    400
      KMIN = 1                                                  CORE    401
      KMAX = 0                                                  CORE    402
      K31 = 0                                                   CORE    403
      IF (RNCYC(I) .EQ. 1.0) GO TO 6                            CORE    404
      KEY = 1                                                   CORE    405
      KIND = 1                                                  CORE    406
      GO TO 415                                                 CORE    407
    6 KEY = 0                                                   CORE    408
      CYCNO = AINT(RNCYC(I)+0.5)                                CORE    409
      CALL DECIDE(X1,X2,X3,X4,KEY,I,CYCNO,KCYGEN)               CORE    410
 1000 GO TO (10,10,30),KCYGEN                                   CORE    411
   10 KB = 1                                                    CORE    412
      I = I + 1                                                 CORE    413
      IF (KMIN .NE. 1) GO TO 36                                 CORE    414
      IF (I .LE. NPKSN) GO TO 5                                 CORE    415
      RES(LR+1) = X1                                            CORE    416
      RES(LR+2) = X2                                            CORE    417
      INDEX(LR+1) = IND1                                        CORE    418
      INDEX(LR+2) = IND2                                        CORE    419
      LRMAX = LR + 2                                            CORE    420
      GO TO 2000                                                CORE    421
   30 IF (KMIN .NE. 1) GO TO 35                                 CORE    422
   12 I = I + 1                                                 CORE    423
      IF (I .LE. NPKSN) GO TO 31                                CORE    424
      RES(LR+1) = X1                                            CORE    425
      RES(LR+2) = X2                                            CORE    426
      RES(LR+3) = X3                                            CORE    427
      INDEX(LR+1) = IND1                                        CORE    428
      INDEX(LR+2) = IND2                                        CORE    429
      INDEX(LR+3) = IND3                                        CORE    430
```

```
         LRMAX = LR + 3                                          CORE    431
         GO TO 2000                                              CORE    432
   31    X4 = SIGMAX(I)                                          CORE    433
         IND4 = NSTEP(I)                                         CORE    434
         KMAX = 1                                                CORE    435
         KMIN = 0                                                CORE    436
         K31 = 1                                                 CORE    437
   32    IF (RNCYC(I) .GT. 1.0) GO TO 40                         CORE    438
         GO TO 6                                                 CORE    439
   40    KEY = 1                                                 CORE    440
         KIND = 0                                                CORE    441
         GO TO 415                                               CORE    442
   35    X4 = SIGMIN(I)                                          CORE    443
         IND4 = NSTEP(I)                                         CORE    444
         KMIN = 1                                                CORE    445
         KMAX = 0                                                CORE    446
         K31 = 0                                                 CORE    447
         GO TO 32                                                CORE    448
   36    X3 = SIGMIN(I)                                          CORE    449
         IND3 = NSTEP(I)                                         CORE    450
         KMIN = 1                                                CORE    451
         KMAX = 0                                                CORE    452
         GO TO 12                                                CORE    453
  400    KEY = 1                                                 CORE    454
         IF (K3 .NE. 0) GO TO 410                                CORE    455
         X1 = SIGMAX(I)                                          CORE    456
         X2 = SIGMIN(I)                                          CORE    457
         X3 = SIGMAX(I)                                          CORE    458
         X4 = SIGMIN(I)                                          CORE    459
         IND1 = NSTEP(I)                                         CORE    460
         IND2 = IND1                                             CORE    461
         IND3 = IND1                                             CORE    462
         IND4 = IND1                                             CORE    463
         KMIN = 1                                                CORE    464
         KMAX = 0                                                CORE    465
         K31 = 0                                                 CORE    466
         IF (RNCYC(I) .LE. 2.0) GO TO 401                        CORE    467
         RNCYC(I) = RNCYC(I) - 1.0                               CORE    468
         GO TO 402                                               CORE    469
  401    RNCYC(I) = RNCYC(I) - 2.0                               CORE    470
  402    KIND = 0                                                CORE    471
         GO TO 415                                               CORE    472
  410    X3 = SIGMAX(I)                                          CORE    473
         X4 = SIGMIN(I)                                          CORE    474
         IND3 = NSTEP(I)                                         CORE    475
         IND4 = IND3                                             CORE    476
         KMIN = 1                                                CORE    477
         KMAX = 0                                                CORE    478
         K31 = 0                                                 CORE    479
         KIND = 1                                                CORE    480
         RNCYC(I) = RNCYC(I) - 1.0                               CORE    481
         K3 = 0                                                  CORE    482
  415     CYCNO = AINT(RNCYC(I)+0.5)                             CORE    483
         CALL DECIDE(X1,X2,X3,X4,KEY,I,CYCNO,KCYGEN)             CORE    484
         GO TO 1000                                              CORE    485
```

28

```
 2000 LMAX = L
      IF (LRMAX .LT. 4) GO TO 5000
      IF (NCYNO .EQ. 0) GO TO 5000
C
C     RANGE PAIR COUNT OF RESIDUE SPECTRUMS
C
      NRES = NRES + 1
      CALL DEDRES(LRMAX,NCYNO)
      GO TO 2000
 5000 IF (LRMAX .LE. 1) GO TO 3000
C
C     COUNT THE LAST RESIDUE SPECTRUM - RANGE PAIR COUNTING WILL YIELD N
C     ADDITIONAL CYCLES
C
      KK = 0
      RESMAX = RES(1)
      RESMIN = RES(1)
      IMAX = 1
      IMIN = 1
      DO 500 I = 2,LRMAX
      IF (RES(I) .LT. RESMAX) GO TO 490
      RESMAX = RES(I)
      IMAX = I
      GO TO 500
  490 IF (RES(I) .GT. RESMIN) GO TO 500
      RESMIN = RES(I)
      IMIN = I
  500 CONTINUE
      CALL CYCRES(RESMAX,RESMIN,1.0,INDEX(IMAX))
      KK = KK + 1
  510 J = IMAX - 2
      IF (J .LE. 0) GO TO 550
      CALL CYCRES(RES(J),RES(J+1),1.0,INDEX(J))
      KK = KK + 1
      IMAX = J
      GO TO 510
  550 J = IMIN + 2
      IF (J .GT. LRMAX) GO TO 575
      CALL CYCRES(RES(J-1),RES(J),1.0,INDEX(J-1))
      KK = KK + 1
      IMIN = J
      GO TO 550
  575 KMAX = KK
      LMAX = L
C
C     SORT THE ANALYSIS SPECTRUM TO PRODUCE THE RANGE PAIR COUNTED SPECT
C
 3000 KP = 0
      DO 605 JJ = 1,NPKS
      KC = 0
      DO 600 I = 1,LMAX
      IF (NNSTEP(I) .NE. JJ) GO TO 600
      KP = KP + 1
      KC = KC + 1
      NSTEP(KP) = KP
```

```
      SUBROUTINE DECIS(X1,X2,X3,X4,KEY,I,CYCNO,KCYGEN)                    CORE  581
      COMMON/MDEC1/SIGMAX(200),SIGMIN(200)                                CORE  582
      COMMON/MDEC2/NSTEP(900),LR,KMAX,KMIN,K31                            CORE  583
      COMMON/MDECR/RES(1400),INDEX(1400),IND1,IND2,IND3,IND4,KIND         CORE  584
      COMMON/MCYG/CYCLE(900,2),RNECYC(900),NNSTEP(900)                    CORE  585
      COMMON/MCGDE/L,LIND                                                 CORE  586
C                                                                         CORE  587
C     THIS SUBROUTINE DECIDES WHETHER OR NOT THE VALUES X1,X2,X3, AND X4 CORE  588
C     FROM THE ADJUSTED LOAD SPECTRUM SATISFY THE RANGE PAIR COUNTING CO CORE  589
C                                                                         CORE  590
      KFIRST = 0                                                          CORE  591
      IF (K31 .NE. 0) GO TO 11                                            CORE  592
   10 IF (X3 .LE. X2) GO TO 200                                           CORE  593
   11 IF (X2 .GT. X1) GO TO 210                                           CORE  594
      IF (X2 .LT. X4 .OR. X3 .GT. X1) GO TO 500                           CORE  595
  150 IF (X2 .GT. X3) GO TO 151                                           CORE  596
      CALL CYCGEN(X3,X2,1.0,NSTEP(I))                                     CORE  597
      GO TO 152                                                           CORE  598
  151 CALL CYCGEN(X2,X3, 1.0,NSTEP(I))                                    CORE  599
  152 X1 = X1                                                             CORE  600
      X2 = X4                                                             CORE  601
      IF (IND3 .NE. IND2) LIND = 1                                        CORE  602
      IND2 = IND4                                                         CORE  603
      KCYGEN = 1                                                          CORE  604
      IF (KEY .NE. 0) GO TO 110                                           CORE  605
      RETURN                                                              CORE  606
  210 IF (X2 .GT. X4 .OR. X3 .LT. X1) GO TO 500                           CORE  607
      GO TO 150                                                           CORE  608
  200 X1 = X1                                                             CORE  609
      X2 = X4                                                             CORE  610
      IND2 = IND4                                                         CORE  611
      KCYGEN = 2                                                          CORE  612
      IF (KEY .EQ. 0) RETURN                                              CORE  613
      CYCNO = CYCNO - 1.0                                                 CORE  614
      GO TO 110                                                           CORE  615
C                                                                         CORE  616
C     ADD X1 TO THE RESIDUE SPECTRUM                                      CORE  617
C                                                                         CORE  618
  500 LR = LR + 1                                                         CORE  619
      RES(LR) = X1                                                        CORE  620
      INDEX(LR) = IND1                                                    CORE  621
      X1 = X2                                                             CORE  622
      X2 = X3                                                             CORE  623
      X3 = X4                                                             CORE  624
      IND1 = IND2                                                         CORE  625
      IND2 = IND3                                                         CORE  626
      IND3 = IND4                                                         CORE  627
      KCYGEN = 3                                                          CORE  628
      IF (KEY .NE. 0) GO TO 110                                           CORE  629
      RETURN                                                              CORE  630
  110 GO TO (1150,1200,1500),KCYGEN                                       CORE  631
 1150 IF (CYCNO .GT. 1.0) GO TO 1151                                      CORE  632
      IF (CYCNO .EQ. 0.0) RETURN                                          CORE  633
 1153 CYCNO = CYCNO - 1.0                                                 CORE  634
      GO TO 1152                                                          CORE  635
```

32

```
      1151 IF (LIND .EQ. 1) GO TO 1153                                  CORE  636
           IF (IND3 .NE. IND4) GO TO 1153                               CORE  637
           RNECYC(L) = RNECYC(L) + CYCNO - 2.0                          CORE  638
           CYCNO = 1.0                                                  CORE  639
      1152 IF (KMAX .NE. 1) GO TO 111                                   CORE  640
           X3 = SIGMIN(I)                                               CORE  641
           IND3 = NSTEP(I)                                              CORE  642
           IF (CYCNO .NE. 0.0) GO TO 112                                CORE  643
           KMIN = 1                                                     CORE  644
           KMAX = 0                                                     CORE  645
           KCYGEN = 3                                                   CORE  646
           RETURN                                                       CORE  647
      1200 IF (CYCNO .EQ. 0.0) RETURN                                   CORE  648
           CYCNO = CYCNO - 1.0                                          CORE  649
           X3 = SIGMAX(I)                                               CORE  650
           X4 = SIGMIN(I)                                               CORE  651
           KFIRST = 1                                                   CORE  652
           GO TO 113                                                    CORE  653
       111 X3 = SIGMAX(I)                                               CORE  654
           X4 = SIGMIN(I)                                               CORE  655
           IF (KFIRST .NE. 0) GO TO 113                                 CORE  656
           CYCNO = CYCNO - 1.0                                          CORE  657
           KFIRST = 1                                                   CORE  658
       113 IND3 = NSTEP(I)                                              CORE  659
           IND4 = IND3                                                  CORE  660
           KMIN = 1                                                     CORE  661
           KMAX = 0                                                     CORE  662
           GO TO 11                                                     CORE  663
      1500 IF (KMAX .NE. 0) GO TO 1510                                  CORE  664
           IF (CYCNO .EQ. 0.0) RETURN                                   CORE  665
           CYCNO = CYCNO - 1.0                                          CORE  666
       112 X4 = SIGMAX (I)                                              CORE  667
           IND4 = NSTEP(I)                                              CORE  668
           KMAX = 1                                                     CORE  669
           KMIN = 0                                                     CORE  670
           GO TO 11                                                     CORE  671
      1510 X4 = SIGMIN(I)                                               CORE  672
           IND4 = NSTEP(I)                                              CORE  673
           KMAX = 0                                                     CORE  674
           KMIN = 1                                                     CORE  675
           GO TO 10                                                     CORE  676
           END                                                          CORE  677
```

```
      SUBROUTINE DECRES(LRMAX,NOYND)                                    CORE     678
      COMMON/MCGDE/L,LIND                                               CORE     679
      COMMON/MDECR/RES(1400),INDEX(1400),IND1,IND2,IND3,IND4,KIND       CORE     680
C                                                                       CORE     681
C     THIS SUBROUTINE DECIDES WHETHER OR NOT THE ELEMENTS OF THE RESIDUE CORE     682
C     SPECTRUM SATISFY THE RANGE PAIR COUNTING CONDITIONS               CORE     683
C                                                                       CORE     684
      K = 0                                                             CORE     685
      NOYND = 0                                                         CORE     686
      X1 = RES(1)                                                       CORE     687
      X2 = RES(2)                                                       CORE     688
      X3 = RES(3)                                                       CORE     689
      X4 = RES(4)                                                       CORE     690
      IND1 = INDEX(1)                                                   CORE     691
      IND2 = INDEX(2)                                                   CORE     692
      IND3 = INDEX(3)                                                   CORE     693
      IND4 = INDEX(4)                                                   CORE     694
      J = 4                                                             CORE     695
   10 IF (X2 .GT. X1) GO TO 100                                         CORE     696
      IF (X2 .LT. X4 .OR. X3 .GT. X1) GO TO 500                         CORE     697
  150 IF (X2 .GT. X3) GO TO 151                                         CORE     698
      CALL CYCRES(X3,X2,1.0,IND3)                                       CORE     699
      GO TO 152                                                         CORE     700
  151 CALL CYCRES(X2,X3,1.0,IND2)                                       CORE     701
  152 NOYND = NOYND + 1                                                 CORE     702
      X1 = X1                                                           CORE     703
      X2 = X4                                                           CORE     704
      IND2 = IND4                                                       CORE     705
      IF (J .EQ. LRMAX) GO TO 300                                       CORE     706
      IF ((J + 1) .EQ. LRMAX) GO TO 315                                 CORE     707
      X3 = RES(J+1)                                                     CORE     708
      X4 = RES(J+2)                                                     CORE     709
      IND3 = INDEX(J+1)                                                 CORE     710
      IND4 = INDEX(J+2)                                                 CORE     711
      J = J+2                                                           CORE     712
      GO TO 10                                                          CORE     713
  100 IF (X2 .GT. X4 .OR. X3 .LT. X1) GO TO 500                         CORE     714
      GO TO 150                                                         CORE     715
  500 K = K + 1                                                         CORE     716
      RES(K) = X1                                                       CORE     717
      INDEX(K) = IND1                                                   CORE     718
      J = J + 1                                                         CORE     719
      IF (J .GT. LRMAX) GO TO 330                                       CORE     720
      X1 = X2                                                           CORE     721
      X2 = X3                                                           CORE     722
      X3 = X4                                                           CORE     723
      X4 = RES(J)                                                       CORE     724
      IND1 = IND2                                                       CORE     725
      IND2 = IND3                                                       CORE     726
      IND3 = IND4                                                       CORE     727
      IND4 = INDEX(J)                                                   CORE     728
      GO TO 10                                                          CORE     729
  300 K = K + 1                                                         CORE     730
      RES(K) = X1                                                       CORE     731
      RES(K+1) = X2                                                     CORE     732
```

34

```
      INDEX(K) = IND1                                     CORE   733
      INDEX(K+1) = IND2                                   CORE   734
      LRMAX = K + 1                                       CORE   735
      RETURN                                              CORE   736
  315 K = K + 1                                           CORE   737
      RES(K) = X1                                         CORE   738
      RES(K+1) = X2                                       CORE   739
      RES(K+2) = RES(J+1)                                 CORE   740
      INDEX(K) = IND1                                     CORE   741
      INDEX(K+1) = IND2                                   CORE   742
      INDEX(K+2) = INDEX(J+1)                             CORE   743
      LRMAX = K + 2                                       CORE   744
      RETURN                                              CORE   745
  330 K = K + 1                                           CORE   746
      RES(K) = X2                                         CORE   747
      RES(K+1) = X3                                       CORE   748
      RES(K+2) = X4                                       CORE   749
      INDEX(K) = IND2                                     CORE   750
      INDEX(K+1) = IND3                                   CORE   751
      INDEX(K+2) = IND4                                   CORE   752
      LRMAX = K + 2                                       CORE   753
      RETURN                                              CORE   754
      END                                                 CORE   755
```

```
      SUBROUTINE CYCRES(Y1,Y2,  CYCPF,NSTEPP)                             CORE     755
      COMMON/MCYG/CYCLE(900,2),RNECYC(900),NNSTEP(900)                    CORE     757
      COMMON/MGGDE/L,LINO                                                 CORE     758
C                                                                         CORE     759
C     THIS SUBROUTINE GENERATES CYCLES FOR THE ANALYSIS SPECTRUM FROM DA CORE     760
C     SUPPLIED BY SUBROUTINE DECRES                                       CORE     761
C                                                                         CORE     762
      L = L + 1                                                           CORE     763
      CYCLE(L,1) = Y1                                                     CORE     764
      CYCLE(L,2) = Y2                                                     CORE     765
      RNECYC(L) = CYCPF                                                   CORE     766
      NNSTEP(L) = NSTEPP                                                  CORE     767
      RETURN                                                              CORE     768
      END                                                                 CORE     769
```

APPENDIX II

SAMPLE PROBLEM WITH INPUT DATA LISTING

```
1 DATA DECKS ARE TO BE PROCESSED.

SPECTRUM SUBJECTED TO THE RANGE-PAIR COUNTING TECHNIQUE
SEQUENCE ACCOUNTABLE FATIGUE EVALUATION
```

SPECTRUM FROM B-1 SPECTRUM -- TRUNCATION LEVEL 270,000 CYCLES
MATERIAL TYPE -- 2219-T851 AL

TENSILE YIELD STRESS (KSI) -- 55.00000

LCF STRAIN INTERCEPT = .40000

INVERSE OF COFFIN-MANSON SLOPE -1.83500

ELASTIC MODULUS = 10000.00000

COEFFICIENTS OF SECOND ORDER LEAST SQUARE FIT OF S-N DATA
SMAX = A(I)*SMIN**2 + B(I)*SMIN + C(I)

LIFE	A(I)	B(I)	C(I)
10** 4	-.00217	.22941	55.82462
10** 5	-.00178	.33213	48.26657
10** 6	-.00149	.46283	39.66455
10** 7	-.00243	.64199	31.70955

UNNOTCHED COUPON S-N DATA DERIVED FROM
INFORMATION SUPPLIED FROM NORTH AMERICAN

RESIDUAL STRESS RELAXATION FUNCTION

ENEP = C1/(KTSMAX**E1 * KTSMEAN**E2)
WHERE C1 = .25000000E+07 , E1 = 1.000 AND E2 = 1.000

38 7 TIMES THROUGH BLOCK OF 44 LOADS

LOAD LIMIT = 26.90000

STEP	TYPE	STMIN	STMAX	ENN
1	1	-.14800	-.02900	1.00000
2	3	.58400	1.00000	1.00000
3	2	.58400	.89500	1.00000
4	1	.58400	.68400	1.00000
5	1	.45500	.58400	1.00000
6	1	.64800	.69300	1.00000
7	1	.39500	.69900	1.00000
8	1	.48800	.56300	3.00000
9	1	.23500	.59900	1.00000
10	1	.50900	.62700	2.00000
11	1	.43400	.50900	1.00000
12	1	.36400	.69000	1.00000
13	1	.13300	.36400	1.00000
14	1	.36400	.48200	6.00000
15	1	.30400	.36400	1.00000
16	1	.30700	.75600	1.00000
17	1	.31600	.52700	1.00000
18	2	.54500	.70800	1.00000
19	1	.33400	.61700	1.00000
20	1	.40100	.51200	7.00000
21	1	.12700	.54800	1.00000
22	1	.22900	.37700	48.00000
23	1	-.00600	.34000	1.00000
24	1	.13000	.24400	35.00000
25	1	.07800	.72300	1.00000
26	1	.11100	.55700	9.00000
27	1	.18700	.37700	10.00000
28	3	.52700	.99100	1.00000
29	2	-.12000	.88300	1.00000

30	1	.527[illegible]	.747[illegible]	1.00000
31	1	-.14800	-.02900	1.00000
32	1	.55700	.84600	1.00000
33	1	.50900	.88000	1.00000
34	1	.33100	.52700	1.00000
35	1	.52700	.61700	19.00000
36	1	.46400	.52700	2.00000
37	1	.48200	.81300	1.00000
38	1	.58100	.68700	1.00000
39	1	.32200	.70200	1.00000
40	1	.39500	.44900	9.00000
41	1	.43100	.59900	5.00000
42	1	.46100	.54500	29.00000
43	1	-.14800	-.02900	1.00000
44	1	-.13600	-.03900	1.00000

BLOCK	TYPE	TYPE	TYPE	TYPE	TYPE	TYPE	TYPE	TYPE
1	1	-0	-0					
2	1	-0	-0					
3	2	1	-0					
4	1	-0	-0					
5	3	1	-0					
6	1	-0	-0					
7	1	-0	-0					

SPECTRUM FROM B-1 SPECTRUM -- TRUNCATION LEVEL 270,000 CYCLES

AKT = 4.90

RELAXATION CONSTANT CIR 2500000.00

SPECTRUM SUBJECTED TO THE RANGE-PAIR COUNTING TECHNIQUE

FLIGHT OR BLOCK NO. 1

STMAX	STMIN	SIGMAX	SIGMIN	RES	EQRES	ENN	NEP	
-.78	-3.98	-3.51	-17.92	0.00	0.00	1.00	.13025831E+05	1
18.40	15.71	55.00	42.89	-27.80	-27.80	1.00	.39342782E+03	2
15.71	12.24	42.89	27.20	-27.80	-15.69	1.00	.56235689E+03	3
18.64	17.43	55.00	49.55	-28.89	-28.89	1.00	.36717948E+03	4
18.80	10.63	55.00	18.20	-29.61	-29.61	1.00	.44621680E+03	5
15.14	13.13	38.54	29.46	-29.61	-13.15	3.00	.57667259E+03	6
13.69	6.32	32.20	-.97	-29.42	-6.61	1.00	.90105168E+03	7
16.87	13.69	46.54	32.25	-29.36	-20.90	2.00	.47906511E+03	8
13.69	11.67	32.34	23.26	-29.28	-6.61	1.00	.71090397E+03	9
18.56	9.79	54.32	14.56	-29.21	-28.52	1.00	.46919213E+03	10
9.79	3.58	14.86	-13.10	-29.20	0.00	1.00	.18861779E+04	11
12.97	9.79	29.18	14.90	-29.17	-3.35	6.00	.83680259E+03	12
9.79	8.18	15.32	8.06	-28.74	0.00	1.00	.14033389E+04	13
20.34	8.26	55.00	.65	-36.51	-36.51	1.00	.42460525E+03	14
14.18	8.50	27.28	1.74	-36.51	-8.79	1.00	.76807252E+03	15
16.60	8.98	38.26	4.00	-36.43	-19.69	1.00	.58153350E+03	16
13.77	10.79	25.61	12.18	-36.35	-6.98	7.00	.72996103E+03	17
14.74	3.42	30.61	-20.35	-35.72	-11.34	1.00	.92247814E+03	18
10.14	6.16	9.97	-7.94	-35.66	0.00	48.00	.14935730E+04	19
		10.11	-7.81			4.80		4.80000000
		10.37	-7.55			9.60		4.80000000
		10.63	-7.29			14.40		4.80000000
		10.89	-7.03			19.20		4.80000000
		11.14	-6.77			24.00		4.80000000
		11.40	-6.52			28.80		4.80000000
		11.65	-6.27			33.60		4.80000000
		11.90	-6.02			38.40		4.80000000
		12.15	-5.77			43.20		4.80000000
		12.40	-5.52			48.00		4.80000000
9.15	-.16	8.04	-33.84	-33.12	0.00	1.00	.30047963E+04	20
6.56	3.50	-3.56	-17.36	-33.09	0.00	35.00	.37392025E+04	21
		-3.52	-17.32			3.50		3.50000000
		-3.45	-17.25			7.00		3.50000000
		-3.38	-17.18			10.50		3.50000000
		-3.31	-17.11			14.00		3.50000000
		-3.24	-17.04			17.50		3.50000000
		-3.17	-16.97			21.00		3.50000000
		-3.10	-16.90			24.50		3.50000000
		-3.03	-16.83			28.00		3.50000000
		-2.96	-16.76			31.50		3.50000000
		-2.89	-16.69			35.00		3.50000000
19.45	2.10	55.00	-23.08	-32.52	-32.52	1.00	.58920931E+03	22
14.98	2.99	34.91	-19.08	-32.52	-12.42	9.00	.91708325E+03	23
10.14	5.03	13.57	-9.43	-32.07	0.00	10.00	.16047965E+04	24
20.09	14.18	55.00	28.37	-35.42	-35.42	1.00	.35855054E+03	25
-.78	-3.98	-38.93	-53.34	-35.42	0.00	1.00	.13025831E+05	26
22.76	14.98	55.00	25.02	-47.41	-47.41	1.00	.28748314E+03	27
23.67	13.69	55.00	10.09	-51.52	-51.52	1.00	.27916148E+03	28
14.18	8.90	12.27	-11.46	-51.52	-8.79	1.00	.75464468E+03	29
16.60	14.18	23.29	12.40	-51.39	-19.69	19.00	.48342514E+03	30
		23.44	12.54			1.90		1.90000000
		23.72	12.83			3.80		1.90000000
		24.00	13.11			5.70		1.90000000

		24.28	13.39			7.60		1.90000000
		24.56	13.66			9.50		1.90000000
		24.83	13.94			11.40		1.90000000
		25.11	14.21			13.30		1.90000000
		25.37	14.48			15.20		1.90000000
		25.64	14.75			17.10		1.90000000
		25.91	15.01			19.00		1.90000000
14.18	12.48	15.14	7.52	-48.65	-8.79	2.00	.65336542E+03	31
21.79	12.97	49.68	9.98	-48.37	-43.05	1.00	.32605652E+03	32
18.48	15.63	34.83	22.00	-48.33	-28.16	1.00	.39170979E+03	33
18.88	8.66	36.76	-9.24	-48.21	-29.98	1.00	.47468264E+03	34
12.08	10.63	6.23	-.31	-48.13	0.00	9.00	.90043347E+03	35
15.87	11.59	24.39	5.14	-47.03	-16.42	5.00	.56645141E+03	36
14.66	12.40	19.56	9.39	-46.41	-10.97	29.00	.62236611E+03	37
		19.75	9.58			2.90		2.90000000
		20.12	9.95			5.80		2.90000000
		20.50	10.33			8.70		2.90000000
		20.86	10.70			11.60		2.90000000
		21.23	11.06			14.50		2.90000000
		21.59	11.42			17.40		2.90000000
		21.94	11.78			20.30		2.90000000
		22.30	12.13			23.20		2.90000000
		22.65	12.48			26.10		2.90000000
		22.99	12.82			29.00		2.90000000
-.78	-3.98	-40.60	-55.00	-37.08	0.00	1.00	.13025831E+05	38
-1.05	-3.66	-41.80	-53.54	-37.08	0.00	1.00	.14337171E+05	39

THE NUMBER OF PEAKS OR VALLEYS IN THE INPUT LOAD SPECTRUM = 75

STEP	SIGMA MAXIMUM	SIGMA MINIMUM	COUNTER K
1	-.351045E+01	-.179154E+02	1.00000
2	.550000E+02	.428950E+02	1.00000
3	.428950E+02	.272795E+02	1.00000
4	.550000E+02	.495527E+02	1.00000
5	.550000E+02	.182008E+02	1.00000
6	.385372E+02	.294585E+02	3.00000
7	.321966E+02	-.971139E+00	1.00000
8	.465387E+02	.322548E+02	2.00000
9	.323357E+02	.232570E+02	1.00000
10	.543191E+02	.148568E+02	1.00000
11	.148601E+02	-.131024E+02	1.00000
12	.291797E+02	.148958E+02	6.00000
13	.153186E+02	.805562E+01	1.00000
14	.550000E+02	.648550E+00	1.00000
15	.272796E+02	.173800E+01	1.00000
16	.382570E+02	.399989E+01	1.00000
17	.256130E+02	.121764E+02	7.00000
18	.306127E+02	-.203494E+02	1.00000
19	.101054E+02	-.781000E+01	4.80000
20	.103674E+02	-.754800E+01	4.80000
21	.106275E+02	-.728793E+01	4.80000
22	.108856E+02	-.702978E+01	4.80000
23	.111419E+02	-.677353E+01	4.80000
24	.113962E+02	-.651917E+01	4.80000
25	.116487E+02	-.626669E+01	4.80000
26	.118993E+02	-.601607E+01	4.80000
27	.121481E+02	-.576729E+01	4.80000
28	.123950E+02	-.552036E+01	4.80000
29	.803921E+01	-.338441E+02	1.00000
30	-.352059E+01	-.173203E+02	3.50000
31	-.344941E+01	-.172491E+02	3.50000
32	-.337838E+01	-.171781E+02	3.50000
33	[illegible]	[illegible]	

34	-.323678E+01	-.170365E+02	3.50000
35	-.316621E+01	-.169659E+02	3.50000
36	-.309579E+01	-.168955E+02	3.50000
37	-.302552E+01	-.168252E+02	3.50000
38	-.295540E+01	-.167551E+02	3.50000
39	-.288544E+01	-.166851E+02	3.50000
40	.550000E+02	-.230772E+02	1.00000
41	.349357E+02	-.190826E+02	9.00000
42	.135658E+02	-.943374E+01	10.00000
43	.550000E+02	.283690E+02	1.00000
44	-.389348E+02	-.533397E+02	1.00000
45	.550000E+02	.200165E+02	1.00000
46	.550000E+02	.100905E+02	1.00000
47	.122694E+02	-.114564E+02	1.00000
48	.234369E+02	.125424E+02	1.90000
49	.237213E+02	.128268E+02	1.90000
50	.240031E+02	.131086E+02	1.90000
51	.242824E+02	.133879E+02	1.90000
52	.245592E+02	.136647E+02	1.90000
53	.248335E+02	.139390E+02	1.90000
54	.251053E+02	.142108E+02	1.90000
55	.253747E+02	.144802E+02	1.90000
56	.256416E+02	.147471E+02	1.90000
57	.259062E+02	.150117E+02	1.90000
58	.151434E+02	.751720E+01	2.00000
59	.496805E+02	.997609E+01	1.00000
60	.348288E+02	.219975E+02	1.00000
61	.367628E+02	-.923622E+01	1.00000
62	.622539E+01	-.311306E+00	9.00000
63	.243886E+02	.514165E+01	5.00000
64	.197465E+02	.957830E+01	2.90000
65	.201228E+02	.995459E+01	2.90000
66	.204951E+02	.103269E+02	2.90000
67	.208634E+02	.106952E+02	2.90000
68	.212277E+02	.110595E+02	2.90000
69	.215882E+02	.114200E+02	2.90000
70	.219448E+02	.117766E+02	2.90000
71	.222977E+02	.121295E+02	2.90000
72	.226467E+02	.124785E+02	2.90000
73	.229920E+02	.128238E+02	2.90000
74	-.405950E+02	-.550000E+02	1.00000
75	-.417990E+02	-.535408E+02	1.00000

RANGE PAIR CYCLE COUNTED SPECTRUM

STEP	SIGMA MAXIMUM	SIGMA MINIMUM	COUNTER K
1	-.351045E+01	-.179154E+02	1.00000
2	.550000E+02	.272795E+02	1.00000
3	.550000E+02	.495527E+02	1.00000
4	.550000E+02	-.550000E+02	1.00000
5	.321966E+02	.294585E+02	1.00000
6	.465387E+02	.322548E+02	1.00000
7	.465387E+02	.232570E+02	1.00000
8	.323357E+02	.322548E+02	1.00000
9	.543191E+02	-.971139E+00	1.00000
10	.148601E+02	.148568E+02	1.00000
11	.291797E+02	.148958E+02	5.00000
12	.291797E+02	.805562E+01	1.00000
13	.153186E+02	.148958E+02	1.00000
14	.550000E+02	-.131024E+02	1.00000
15	.272796E+02	.173800E+01	1.00000
16	.382570E+02	.648550E+00	1.00000
17	.306127E+02	.121764E+02	1.00000
18	.101054E+02	-.781000E+01	5.00000
19	.103674E+02	-.754800E+01	5.00000
20	.106275E+02	-.728793E+01	5.00000
21	.108856E+02	-.702978E+01	5.00000
22	.111419E+02	-.677353E+01	5.00000
23	.113962E+02	-.651917E+01	5.00000
24	.116487E+02	-.626669E+01	5.00000
25	.118993E+02	-.601607E+01	5.00000
26	.121481E+02	-.576729E+01	5.00000
27	.123950E+02	-.552036E+01	4.00000
28	.123950E+02	-.203494E+02	1.00000
29	.803921E+01	-.552036E+01	1.00000
30	-.352059E+01	-.173203E+02	4.00000
31	-.344941E+01	-.172491E+02	4.00000
32	-.337838E+01	-.171781E+02	4.00000
33	-.330750E+01	-.171072E+02	4.00000
34	-.323678E+01	-.170365E+02	4.00000
35	-.316621E+01	-.169659E+02	4.00000
36	-.309579E+01	-.168955E+02	4.00000
37	-.302552E+01	-.168252E+02	4.00000
38	-.295540E+01	-.167551E+02	4.00000
39	-.288544E+01	-.166851E+02	4.00000
40	.550000E+02	-.190826E+02	1.00000
41	.135658E+02	-.943374E+01	10.00000
42	.550000E+02	-.338441E+02	1.00000
43	.550000E+02	.200165E+02	1.00000
44	.550000E+02	-.533397E+02	1.00000
45	.234369E+02	.125424E+02	2.00000
46	.237213E+02	.128268E+02	2.00000
47	.240031E+02	.131086E+02	2.00000
48	.242824E+02	.133879E+02	2.00000
49	.245592E+02	.136647E+02	2.00000
50	.248335E+02	.139390E+02	2.00000
51	.251053E+02	.142108E+02	2.00000
52	.253747E+02	.144802E+02	2.00000
53	.256416E+02	.147471E+02	2.00000
54	.259062E+02	.150117E+02	1.00000
55	.259062E+02	.751720E+01	1.00000
56	.151434E+02	.150117E+02	1.00000
57	.151434E+02	.751720E+01	1.00000

58	.4968[illegible]E+02	-.114564E+02	1.00000
59	.[illegible]8266E+02	.219975E+02	1.00000
[illegible]	.[illegible]2[illegible]E+02	.997609E+01	1.00000
61	.243885E+02	.514165E+01	4.00000
62	.243886E+02	-.311326E+00	1.00000
63	.197465E+02	.957830E+01	3.00000
64	.201228E+02	.995459E+01	3.00000
65	.204951E+02	.103269E+02	3.00000
66	.208634E+02	.106952E+02	3.00000
67	.212277E+02	.110595E+02	3.00000
68	.215882E+02	.114200E+02	3.00000
69	.219448E+02	.117766E+02	3.00000
70	.222977E+02	.121295E+02	3.00000
71	.226467E+02	.124785E+02	3.00000
72	.229920E+02	.128238E+02	2.00000
73	.229920E+02	.514165E+01	1.00000
74	-.417990E+02	-.535458E+02	1.00000

LOCAL STRESSES AND PLASTIC STRAINS W/RESULTING FATIGUE LIFE

STEP	PLASTIC STRAIN	MAX OR MIN	DAMAGE
2	.01696	MAX	.589085E-03
4	.00035	MAX	.236703E-05
5	.00022	MAX	.105771E-05
14	.00249	MAX	.891548E-04
22	.00004	MAX	.498022E-07
25	.00123	MAX	.242990E-04
27	.00420	MAX	.233133E-03
28	.00156	MAX	.379281E-04
38	.00063	MIN	.718916E-05

DAMAGE FROM PLASTIC STRAINS= .98426328E-03

SIGMAX	SIGMIN	RNCYC	CYCLES	ENN/CYC
-3.51	-17.92	1.	.10000000E+10	.10000000E-08
55.00	27.28	1.	.14807856E+06	.67531722E-05
55.00	49.55	1.	.69900694E+09	.14306010E-08
55.00	-55.00	1.	.10000000E+05	.10000000E-03
32.29	29.46	1.	.46901918E+12	.21321090E-11
46.54	32.25	1.	.11536870E+09	.86678619E-08
46.54	23.26	1.	.51785551E+07	.19310406E-06
32.34	32.25	1.	.36726287E+13	.27228454E-12
54.32	-.97	1.	.14931857E+05	.66970905E-04
14.86	14.86	1.	.50066416E+12	.19973469E-11
29.18	14.90	5.	.12665797E+10	.39476395E-08
29.18	8.06	1.	.14052164E+09	.71163418E-08
15.32	14.90	1.	.42187482E+12	.23703714E-11
55.00	-13.10	1.	.10000000E+05	.10000000E-03
27.28	1.74	1.	.53004668E+08	.18866263E-07
38.26	.65	1.	.17454008E+07	.57293429E-06
30.61	12.18	1.	.27966528E+09	.35757031E-08
10.11	-7.81	5.	.10000000E+10	.50000000E-08
10.37	-7.55	5.	.10000000E+10	.50000000E-08
10.63	-7.29	5.	.10000000E+10	.50000000E-08
10.89	-7.03	5.	.10000000E+10	.50000000E-08
11.14	-6.77	5.	.56054816E+09	.89198403E-08
11.40	-6.52	5.	.56088584E+09	.89144700E-08
11.65	-6.27	5.	.56115089E+09	.89102593E-08
11.90	-6.02	5.	.56134367E+09	.89071993E-08
12.15	-5.77	5.	.56146456E+09	.89052816E-08
12.40	-5.52	4.	.56151397E+09	.71235984E-08
12.40	-20.35	1.	.27376289E+08	.36527961E-07
8.04	-5.52	1.	.10000000E+10	.10000000E-08
-3.52	-17.32	4.	.10000000E+10	.40000000E-08
-3.45	-17.25	4.	.10000000E+10	.40000000E-08
-3.38	-17.18	4.	.10000000E+10	.40000000E-08

-3.31	-17.11	4.	.10000000E+10	.40000000E-08
-3.24	-17.04	4.	.10000000E+10	.40000000E-08
-3.17	-16.97	4.	.10000000E+10	.40000000E-08
-3.10	-16.90	4.	.10000000E+10	.40000000E-08
-3.03	-16.83	4.	.10000000E+10	.40000000E-08
-2.96	-16.76	4.	.10000000E+10	.40000000E-08
-2.89	-16.69	4.	.10000000E+10	.40000000E-08
55.00	-19.08	1.	.10000000E+05	.10000000E-03
13.57	-9.43	10.	.16603817E+09	.60227117E-07
55.00	-33.84	1.	.10000000E+05	.10000000E-03
55.00	20.02	1.	.63546690E+05	.15736461E-04
55.00	-53.34	1.	.10000000E+05	.10000000E-03
23.44	12.54	2.	.52786328E+10	.37888599E-09
23.72	12.83	2.	.52805280E+10	.37875000E-09
24.00	13.11	2.	.52807566E+10	.37873361E-09
24.28	13.39	2.	.52793259E+10	.37883625E-09
24.56	13.66	2.	.52762450E+10	.37905745E-09
24.83	13.94	2.	.52715248E+10	.37939687E-09
25.11	14.21	2.	.52651779E+10	.37985421E-09
25.37	14.48	2.	.52572184E+10	.38042931E-09
25.64	14.75	2.	.52476624E+10	.38112208E-09
25.91	15.01	1.	.52365271E+10	.19096626E-09
25.91	7.52	1.	.37589154E+09	.26603419E-08
15.14	15.01	1.	.48307951E+12	.20700526E-11
15.14	7.52	1.	.15515977E+11	.64449697E-10
49.68	-11.46	1.	.24152055E+05	.41404344E-04
34.83	22.00	1.	.15814258E+10	.63234078E-09
36.76	9.98	1.	.15038306E+08	.66496853E-07
24.39	5.14	4.	.31310615E+09	.12775220E-07
24.39	-.31	1.	.77428372E+08	.12915162E-07
19.75	9.58	3.	.67337984E+10	.44551379E-09
20.12	9.95	3.	.67798754E+10	.44248601E-09
20.50	10.33	3.	.68230691E+10	.43968484E-09
20.86	10.70	3.	.68633296E+10	.43710563E-09
21.23	11.06	3.	.69036119E+10	.43474405E-09
21.59	11.42	3.	.69348755E+10	.43259609E-09
21.94	11.78	3.	.69660846E+10	.43065799E-09
22.30	12.13	3.	.69942085E+10	.42892630E-09
22.65	12.48	3.	.70192214E+10	.42739783E-09
22.99	12.82	2.	.70411021E+10	.28404644E-09
22.99	5.14	1.	.49378912E+09	.20251560E-08
-41.80	-53.54	1.	.10000000E+10	.10000000E-08

DAMAGE PER THIS SET= .16162546E-02

TOTAL ENN/CYC =, .16162546E-02

FLIGHT OR BLOCK NO. 2

STMAX	STMIN	SIGMAX	SIGMIN	RES	EQRES	ENN	NEP	
-.78	-3.98	-40.58	-54.99	-37.07	0.00	1.00	.13025831E+05	1
18.40	15.71	45.73	33.63	-37.07	-27.80	1.00	.39342782E+03	2
15.71	12.24	33.68	18.37	-37.01	-15.69	1.00	.56235689E+03	3
18.64	17.43	46.96	41.52	-36.92	-28.89	1.00	.36717948E+03	4
18.80	10.63	47.74	10.94	-36.87	-29.61	1.00	.44621680E+03	5
15.14	13.13	31.31	22.24	-35.84	-13.15	3.00	.57667259E+03	6
13.69	6.32	25.06	-8.11	-36.55	-6.61	1.00	.90105168E+03	7
16.87	13.69	39.42	25.14	-36.48	-20.90	2.00	.47906511E+03	8
13.69	11.67	25.29	16.21	-36.33	-6.61	1.00	.71099397E+03	9
18.56	9.79	47.29	7.83	-36.23	-28.52	1.00	.46919213E+03	10
9.79	3.58	7.87	-20.13	-36.20	0.00	1.00	.18861779E+04	11
12.97	9.79	22.20	7.91	-35.15	-3.35	6.00	.83680259E+03	12
9.79	8.18	8.45	1.19	-35.61	0.00	1.00	.14033389E+04	13
20.34	8.26	55.00	.65	-36.51	-36.51	1.00	.42460525E+03	14
14.18	8.50	27.28	1.74	-36.51	-8.79	1.00	.76807252E+03	15
16.60	8.98	38.26	4.00	-36.43	-19.69	1.00	.58153350E+03	16
13.77	10.79	25.61	12.18	-36.35	-6.98	7.00	.72996103E+03	17
14.74	3.42	30.61	-20.35	-35.72	-11.34	1.00	.92247814E+03	18

10.14	6.16	9.97	-7.34	-35.65	[illegible]	48.00	.14935733E+04	19
		[illegible]	[illegible]			4.80		4.80000000
		[illegible]	[illegible]			9.60		4.80000000
		[illegible]	-7.29			14.40		4.80000000
		[illegible]	-7.03			19.20		4.80000000
		[illegible]	-6.77			24.00		4.80000000
		11.40	-6.52			28.80		4.80000000
		11.65	-6.27			33.60		4.80000000
		11.90	-6.02			38.40		4.80000000
		12.15	-5.77			43.20		4.80000000
		12.40	-5.52			48.00		4.80000000
9.15	-.16	8.04	-33.84	-33.12	0.00	1.00	.30047963E+04	20
6.56	3.50	-3.56	-17.36	-33.09	0.00	35.00	.37392025E+04	21
		-3.52	-17.32			3.50		3.50000000
		-3.45	-17.25			7.00		3.50000000
		-3.38	-17.18			10.50		3.50000000
		-3.31	-17.11			14.00		3.50000000
		-3.24	-17.04			17.50		3.50000000
		-3.17	-16.97			21.00		3.50000000
		-3.10	-16.90			24.50		3.50000000
		-3.03	-16.83			28.00		3.50000000
		-2.96	-16.76			31.50		3.50000000
		-2.89	-16.69			35.00		3.50000000
19.45	2.10	55.00	-23.38	-32.52	-32.52	1.00	.58923931E+03	22
14.98	2.99	34.91	-19.08	-32.52	-12.42	9.00	.91708325E+03	23
10.14	5.03	13.57	-9.43	-32.17	0.00	10.00	.16047965E+04	24
20.39	14.18	55.00	28.37	-35.42	-35.42	1.00	.35855054E+03	25
-.78	-3.98	-38.93	-53.34	-35.42	0.00	1.00	.13025831E+05	26
22.76	14.98	55.00	20.07	-47.41	-47.41	1.00	.28748314E+03	27
23.67	13.69	55.00	10.39	-51.52	-51.52	1.00	.27916148E+03	28
14.18	8.90	12.27	-11.46	-51.52	-8.79	1.00	.75464468E+03	29
16.60	14.18	23.29	12.40	-51.39	-19.69	19.00	.48342514E+03	30
		23.44	12.54			1.90		1.90000000
		23.72	12.83			3.80		1.90000000
		24.00	13.11			5.70		1.90000000
		24.28	13.39			7.60		1.90000000
		24.56	13.66			9.50		1.90000000
		24.83	13.94			11.40		1.90000000
		25.11	14.21			13.30		1.90000000
		25.37	14.48			15.20		1.90000000
		25.64	14.75			17.10		1.90000000
		25.91	15.01			19.00		1.90000000
14.18	12.48	15.14	7.52	-48.65	-8.79	2.00	.65336542E+03	31
21.79	12.97	49.68	9.98	-48.37	-43.05	1.00	.32605652E+03	32
18.48	15.63	34.83	22.00	-48.33	-28.15	1.00	.39170979E+03	33
18.88	8.66	36.76	-9.24	-48.21	-29.98	1.00	.47468264E+03	34
12.38	10.63	6.23	-.31	-48.13	0.07	9.00	.90043347E+03	35
15.87	11.59	24.39	5.14	-47.03	-16.42	5.00	.56645141E+03	36
14.66	12.40	19.56	9.39	-46.41	-10.97	29.00	.62236611E+03	37
		19.75	9.58			2.90		2.90000000
		20.12	9.95			5.80		2.90000000
		20.50	10.33			8.70		2.90000000
		20.86	10.70			11.60		2.90000000
		21.23	11.06			14.50		2.90000000
		21.59	11.42			17.40		2.90000000
		21.94	11.78			20.30		2.90000000
		22.30	12.13			23.20		2.90000000
		22.65	12.48			26.10		2.90000000
		22.99	12.82			29.00		2.90000000
-.78	-3.98	-40.60	-55.00	-37.08	0.00	1.00	.13025831E+05	38
-1.05	-3.66	-41.80	-53.54	-37.08	0.00	1.00	.14337171E+05	39

LOCAL STRESSES AND PLASTIC STRAINS W/RESULTING FATIGUE LIFE

STEP * PLASTIC STRAIN MAX OR MIN DAMAGE

14	.00032	MAX	.202856E-05
22	.00004	MAX	.498022E-07
25	.00123	MAX	.242990E-04
27	.00420	MAX	.233133E-03
28	.00156	MAX	.379281E-04
38	.00063	MIN	.718916E-05

DAMAGE FROM PLASTIC STRAINS= .30462764E-03

SIGMAX	SIGMIN	RNCYC	CYCLES	ENN/CYC
-40.58	-54.99	1.	.10000000E+10	.10000000E-08
45.73	18.07	1.	.24093777E+07	.41504493E-06
33.68	33.63	1.	.43206072E+13	.23144895E-12
46.96	41.52	1.	.23661145E+11	.42263381E-10
47.74	-20.10	1.	.19780666E+05	.50554416E-04
25.06	22.24	1.	.27937764E+12	.35793846E-11
39.42	25.14	1.	.50516846E+09	.19795377E-08
39.42	16.21	1.	.24432813E+08	.40928567E-07
25.29	25.14	1.	.15753982E+13	.63476016E-12
47.29	-8.11	1.	.58801786E+05	.17006286E-04
7.87	7.83	1.	.10000000E+10	.10000000E-08
22.20	7.91	5.	.15461310E+10	.32338787E-08
22.20	1.19	1.	.21206560E+09	.47155219E-08
8.45	7.91	1.	.10000000E+10	.10000000E-08
55.00	-53.34	1.	.10000000E+05	.10000000E-03
27.28	1.74	1.	.53004668E+08	.18866263E-07
38.26	.65	1.	.17454008E+07	.57293429E-06
30.61	12.18	1.	.27966528E+09	.35757031E-08
10.11	-7.81	5.	.10000000E+10	.50000000E-08
10.37	-7.55	5.	.10000000E+10	.50000000E-08
10.63	-7.29	5.	.10000000E+10	.50000000E-08
10.89	-7.03	5.	.10000000E+10	.50000000E-08
11.14	-6.77	5.	.56054816E+09	.89198403E-08
11.40	-6.52	5.	.56088584E+09	.89144700E-08
11.65	-6.27	5.	.56115089E+09	.89102593E-08
11.90	-6.02	5.	.56134367E+09	.89071993E-08
12.15	-5.77	5.	.56146456E+09	.89052816E-08
12.40	-5.52	4.	.56151397E+09	.71235984E-08
12.40	-20.35	1.	.27376289E+08	.36527961E-07
8.04	-5.52	1.	.10000000E+10	.10000000E-08
-3.52	-17.32	4.	.10000000E+10	.40000000E-08
-3.45	-17.25	4.	.10000000E+10	.40000000E-08
-3.38	-17.18	4.	.10000000E+10	.40000000E-08
-3.31	-17.11	4.	.10000000E+10	.40000000E-08
-3.24	-17.04	4.	.10000000E+10	.40000000E-08
-3.17	-16.97	4.	.10000000E+10	.40000000E-08
-3.10	-16.90	4.	.10000000E+10	.40000000E-08
-3.03	-16.83	4.	.10000000E+10	.40000000E-08
-2.96	-16.76	4.	.10000000E+10	.40000000E-08
-2.89	-16.69	4.	.10000000E+10	.40000000E-08
55.00	-19.88	1.	.10000000E+05	.10000000E-03
13.57	-9.43	10.	.16603817E+09	.60227117E-07
55.00	-33.84	1.	.10000000E+05	.10000000E-03
55.00	20.02	1.	.63546690E+05	.15736461E-04
55.00	-55.00	1.	.10000000E+05	.10000000E-03
23.44	12.54	2.	.52786328E+10	.37888599E-09
23.72	12.83	2.	.52805280E+10	.37875000E-09
24.00	13.11	2.	.52807566E+10	.37873361E-09
24.28	13.39	2.	.52793259E+10	.37883625E-09
24.56	13.66	2.	.52762450E+10	.37905745E-09
24.83	13.94	2.	.52715248E+10	.37939687E-09
25.11	14.21	2.	.52651779E+10	.37985421E-09
25.37	14.48	2.	.52572184E+10	.38042931E-09
25.64	14.75	2.	.52476624E+10	.38112208E-09
25.91	15.01	1.	.52365271E+10	.19096626E-09
25.91	7.32	1.	.37589154E+09	.26603419E-08
15.14	15.01	1.	.48307951E+12	.20700526E-11

47

15.14	7.52	1.	.15515977E+11	.64449697E-10
[illegible]	[illegible]	1.	.24152955E+05	.41404344E-04
[illegible]	[illegible]	1.	.15814258E+10	.63234078E-09
[illegible]	[illegible]	1.	.15038306E+08	.66496853E-07
[illegible]	[illegible]	4.	.31310615E+09	.12775220E-07
[illegible]	-.31	1.	.77428372E+08	.12915162E-07
19.75	9.58	3.	.67337984E+10	.44551379E-09
20.12	9.95	3.	.67798754E+10	.44248601E-09
20.50	10.33	3.	.68230691E+10	.43968484E-09
20.86	10.70	3.	.68633296E+10	.43710563E-09
21.23	11.06	3.	.69006119E+10	.43474465E-09
21.59	11.42	3.	.69348755E+10	.43259609E-09
21.94	11.78	3.	.69660846E+10	.43065799E-09
22.30	12.13	3.	.69942085E+10	.42892630E-09
22.65	12.48	3.	.70192214E+10	.42739783E-09
22.99	12.82	2.	.70411021E+10	.28404644E-09
22.99	5.14	1.	.49378912E+09	.20251560E-08
-41.80	-53.54	1.	.10000000E+10	.10000000E-08

DAMAGE PER THIS SET= .83070929E-03

TOTAL ENN/CYC =, .24469639E-02

FLIGHT OR BLOCK NO. 3

STMAX	STMIN	SIGMAX	SIGMIN	RES	EQRES	ENN	NEP	
-.78	-3.98	-40.58	-54.93	-37.07	0.00	1.00	.13025831E+05	1
24.08	15.71	55.08	17.35	-53.34	-53.34	1.00	.25777999E+03	2
18.40	15.71	29.46	17.35	-53.34	-27.81	1.00	.39342782E+03	3
15.71	12.24	17.50	1.89	-53.19	-15.69	1.00	.56235689E+03	4
18.64	17.43	30.85	25.40	-53.04	-28.39	1.00	.36717948E+03	5
10.80	16.63	31.73	-5.07	-52.89	-29.61	1.00	.44621680E+03	6
15.14	13.13	15.58	6.31	-52.77	-13.15	3.00	.57667259E+03	7
13.69	6.32	9.32	-23.85	-52.29	-6.61	1.00	.90105168E+03	8
16.07	13.69	23.72	9.44	-52.18	-20.97	2.00	.47986511E+03	9
13.69	11.67	9.74	.66	-51.88	-6.61	1.00	.71090397E+03	10
18.56	9.79	31.79	-7.67	-51.73	-28.52	1.00	.46919213E+03	11
9.79	3.58	-7.56	-35.52	-51.62	0.00	1.00	.18861779E+04	12
12.97	9.79	6.79	-7.49	-51.56	-3.35	6.00	.83680259E+03	13
9.79	8.18	-6.70	-13.97	-50.77	0.00	1.00	.14033389E+04	14
20.34	8.26	40.83	-13.52	-50.68	-36.51	1.00	.42460525E+03	15
14.18	8.50	13.19	-12.35	-50.61	-8.79	1.00	.76807252E+03	16
19.05	14.66	35.22	15.49	-50.48	-30.71	1.00	.38464145E+03	17
16.60	8.98	24.32	-9.93	-50.35	-19.69	1.00	.58153350E+03	18
13.77	10.79	11.74	-1.70	-50.24	-6.98	7.00	.72996103E+03	19
14.74	3.42	17.04	-33.92	-49.30	-11.34	1.00	.92247814E+03	20
10.14	6.16	-3.57	-21.48	-49.20	0.00	48.00	.14935730E+04	21
		-3.39	-21.30			4.80		4.80000000
		-3.02	-20.94			9.60		4.80000000
		-2.66	-20.58			14.40		4.80000000
		-2.31	-20.22			19.20		4.80000000
		-1.96	-19.87			24.00		4.80000000
		-1.60	-19.52			28.80		4.80000000
		-1.26	-19.17			33.60		4.80000000
		-.91	-18.83			38.40		4.80000000
		-.57	-18.48			43.20		4.80000000
		-.23	-18.14			48.00		4.80000000
9.15	-.16	-4.54	-46.42	-45.69	0.00	1.00	.30047963E+04	22
6.56	3.50	-16.12	-29.92	-45.65	0.00	35.00	.37392025E+04	23
		-16.07	-29.87			3.50		3.50000000
		-15.97	-29.77			7.00		3.50000000
		-15.88	-29.68			10.50		3.50000000
		-15.78	-29.58			14.00		3.50000000
		-15.68	-29.48			17.50		3.50000000
		-15.58	-29.38			21.00		3.50000000
		-15.49	-29.29			24.50		3.50000000
		-15.39	-29.19			28.00		3.50000000
		-15.29	-29.09			31.50		3.50000000

		-15.20	-29.00			35.30		3.50000000
19.45	2.10	42.84	-35.24	-44.68	-32.52	1.00	.58920931E+03	24
14.98	2.99	22.79	-31.20	-44.64	-12.42	9.00	.91708325E+03	25
10.14	5.03	1.72	-21.28	-43.92	3.30	10.00	.16047965E+04	26
23.75	-3.23	60.71	-60.71	-46.18	-51.89	1.00	.50647169E+03	27
20.09	14.18	44.22	17.59	-46.21	-35.42	1.00	.35855054E+03	28
-.78	-3.98	-40.60	-55.00	-37.08	0.00	1.00	.13025831E+05	29
22.76	14.98	55.00	20.02	-47.41	-47.41	1.00	.28748314E+03	30
23.67	13.69	55.00	10.09	-51.52	-51.52	1.00	.27916148E+03	31
14.18	8.90	12.27	-11.46	-51.52	-8.79	1.00	.75464468E+03	32
16.60	14.18	23.29	12.40	-51.39	-19.69	19.00	.48342514E+03	33
		23.44	12.54			1.90		1.90000000
		23.72	12.83			3.80		1.90000000
		24.00	13.11			5.70		1.90000000
		24.28	13.39			7.60		1.90000000
		24.56	13.66			9.50		1.90000000
		24.83	13.94			11.40		1.90000000
		25.11	14.21			13.30		1.90000000
		25.37	14.48			15.20		1.90000000
		25.64	14.75			17.10		1.90000000
		25.91	15.01			19.00		1.90000000
14.18	12.48	15.14	7.52	-48.65	-8.79	2.00	.65336542E+03	34
21.79	12.97	49.68	-9.98	-48.37	-43.05	1.00	.32605652E+03	35
18.48	15.63	34.83	22.00	-48.33	-28.15	1.00	.39173979E+03	36
18.88	8.66	36.76	-9.24	-48.21	-29.98	1.00	.47468264E+03	37
12.08	10.63	6.23	-.31	-48.13	0.00	9.00	.90043347E+03	38
15.87	11.59	24.39	5.14	-47.03	-16.42	5.00	.56645141E+03	39
14.66	12.40	19.56	9.39	-46.41	-13.97	29.00	.62236611E+03	40
		19.75	9.58			2.90		2.90000000
		20.12	9.95			5.80		2.90000000
		20.50	10.33			8.70		2.90000000
		20.86	10.70			11.60		2.90000000
		21.23	11.06			14.50		2.90000000
		21.59	11.42			17.40		2.90000000
		21.94	11.78			20.30		2.90000000
		22.30	12.13			23.20		2.90000000
		22.65	12.48			26.10		2.90000000
		22.99	12.82			29.00		2.90000000
-.78	-3.98	-40.60	-55.00	-37.08	0.00	1.00	.13025831E+05	41
-1.05	-3.66	-41.80	-53.54	-37.08	0.00	1.00	.14337171E+05	42

LOCAL STRESSES AND PLASTIC STRAINS W/RESULTING FATIGUE LIFE

STEP	PLASTIC STRAIN	MAX OR MIN	DAMAGE
2	.00593	MAX	.438461E-03
27	.00321	MAX	.141845E-03
29	.00185	MIN	.183981E-04
30	.00365	MAX	.180144E-03
31	.00156	MAX	.379281E-04
41	.00063	MIN	.718916E-05

DAMAGE FROM PLASTIC STRAINS= .82396546E-03

SIGMAX	SIGMIN	RNCYC	CYCLES	ENN/CYC
-40.58	-54.99	1.	.10000000E+10	.10000000E-08
55.00	-46.42	1.	.10000000E+05	.10000000E-03
29.46	17.35	1.	.29397878E+10	.34016060E-09
17.50	17.35	1.	.63000870E+12	.15872797E-11
30.85	25.43	1.	.77590688E+11	.12888145E-10
31.73	1.89	1.	.14305010E+08	.69905579E-07
9.32	6.31	1.	.10000000E+10	.10000000E-08
23.72	9.44	1.	.15092544E+10	.66257884E-09
23.72	.66	1.	.11830863E+09	.84524691E-08
9.74	9.44	1.	.10000000E+10	.10000000E-08
31.79	-23.85	1.	.46704942E+06	.21411011E-05
-7.56	-7.67	1.	.10000000E+10	[illegible]

6.79	-7.49	5.	.10000000E+10	.50000000E-08
6.79	-13.97	1.	.10000000E+10	.10000000E-08
6.76	-7.49	1.	.10000000E+10	.10000000E-08
40.83	-16.52	1.	.26034162E+05	.38455383E-04
33.19	12.35	1.	.97971982E+08	.10207000E-07
35.22	-16.52	1.	.65291215E+06	.15315996E-05
31.74	-1.70	7.	.19249496E+10	.36364588E-08
17.04	-9.93	1.	.66014698E+08	.15148142E-07
-3.02	-20.94	5.	.10000000E+10	.50000000E-08
-2.66	-20.58	5.	.10000000E+10	.50000000E-08
-2.31	-20.22	5.	.10000000E+10	.50000000E-08
-1.96	-19.87	5.	.10000000E+10	.50000000E-08
-1.60	-19.52	5.	.10000000E+10	.50000000E-08
-1.26	-19.17	5.	.10000000E+10	.50000000E-08
-.91	-18.83	5.	.10000000E+10	.50000000E-08
-.57	-18.48	5.	.10000000E+10	.50000000E-08
-.23	-18.14	4.	.10000000E+10	.40000000E-08
-.23	-21.30	1.	.10000000E+10	.10000000E-08
-4.54	-18.14	1.	.10000000E+10	.10000000E-08
-16.07	-29.87	4.	.10000000E+10	.40000000E-08
-15.97	-29.77	4.	.10000000E+10	.40000000E-08
-15.88	-29.68	4.	.10000000E+10	.40000000E-08
-15.78	-29.58	4.	.10000000E+10	.40000000E-08
-15.68	-29.48	4.	.10000000E+10	.40000000E-08
-15.58	-29.38	4.	.10000000E+10	.40000000E-08
-15.49	-29.29	4.	.10000000E+10	.40000000E-08
-15.39	-29.19	4.	.10000000E+10	.40000000E-08
-15.29	-29.09	4.	.10000000E+10	.40000000E-08
-15.20	-29.00	4.	.10000000E+10	.40000000E-08
42.84	-31.20	1.	.24386594E+05	.41006136E-04
1.72	-21.28	10.	.10000000E+10	.10000000E-07
60.71	-55.00	1.	.10000000E+05	.10000000E-03
55.00	20.02	1.	.63546690E+05	.15736461E-04
55.00	-55.00	1.	.10000000E+05	.10000000E-03
23.44	12.54	2.	.52786328E+10	.37888599E-09
23.72	12.83	2.	.52805280E+10	.37875000E-09
24.00	13.11	2.	.52807566E+10	.37873361E-09
24.28	13.39	2.	.52793259E+10	.37883625E-09
24.56	13.66	2.	.52762450E+10	.37905745E-09
24.83	13.94	2.	.52715248E+10	.37939687E-09
25.11	14.21	2.	.52651779E+10	.37985421E-09
25.37	14.48	2.	.52572184E+10	.38042931E-09
25.64	14.75	2.	.52476624E+10	.38112208E-09
25.91	15.01	1.	.52365271E+10	.19096626E-09
25.91	7.52	1.	.37589154E+09	.26603419E-08
15.14	15.01	1.	.48307951E+12	.20700526E-11
15.14	7.52	1.	.15515977E+11	.64449697E-10
49.68	-11.46	1.	.24152055E+05	.41404344E-04
34.83	22.00	1.	.15814258E+10	.63234078E-09
36.76	9.98	1.	.15038306E+08	.66496853E-07
24.39	5.14	4.	.31310615E+09	.12775220E-07
24.39	-.31	1.	.77428372E+08	.12915162E-07
19.75	9.58	3.	.67337984E+10	.44551379E-09
20.12	9.95	3.	.67798754E+10	.44248601E-09
20.50	10.33	3.	.68230691E+10	.43968484E-09
20.86	10.70	3.	.68633296E+10	.43710563E-09
21.23	11.06	3.	.69006119E+10	.43474405E-09
21.59	11.42	3.	.69348755E+10	.43259609E-09
21.94	11.78	3.	.69660846E+10	.43065799E-09
22.30	12.13	3.	.69942085E+10	.42892630E-09
22.65	12.48	3.	.70192214E+10	.42739783E-09
22.99	12.82	2.	.70411021E+10	.28404644E-09
22.99	5.14	1.	.49378912E+09	.20251560E-08
-41.80	-53.54	1.	.10000000E+10	.10000000E-08

DAMAGE PER THIS SET= .12645622E-02

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FLIGHT OR BLOCK NO.    4                    TOTAL ENN/CYC =,  .37115261E-02
                                          DAMAGE FROM PLASTIC STRAINS=  .30462764E-03
                                          DAMAGE PER THIS SET=  .83070929E-03
FLIGHT OR BLOCK NO.    5                    TOTAL ENN/CYC =,  .45422354E-02
                                          DAMAGE FROM PLASTIC STRAINS=  .22665690E-02
                                          DAMAGE PER THIS SET=  .26509046E-02
FLIGHT OR BLOCK NO.    6                    TOTAL ENN/CYC =,  .71931400E-02
                                          DAMAGE FROM PLASTIC STRAINS=  .30462764E-03
                                          DAMAGE PER THIS SET=  .83070929E-03
FLIGHT OR BLOCK NO.    7                    TOTAL ENN/CYC =,  .80238493E-02
                                          DAMAGE FROM PLASTIC STRAINS=  .30462764E-03
                                          DAMAGE PER THIS SET=  .83070929E-03
                                            TOTAL ENN/CYC =,  .88545586E-02
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MEDIA CONVERSION LISTING LABEL/ CARDS

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INPUT FILE                  2         3         4         5         6         7         8         9
RECORD NUMBER  1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890   RECORD NUMBER
                                                                                                                   000001
       1  1  1                                                                                                     000002
       B-1 SPECTRUM  --  TRUNCATION LEVEL  270,000 CYCLES                                                          000003
       2219-T851 AL      55.               .40                    -1.836      10000.                               000004
       -.00217           .22041            55.82462     NORTH AMERICAN   4    2219                                 000005
       -.00176           .33210            48.26657     NORTH AMERICAN   5    2219                                 000006
       -.00149           .46283            39.66455     NORTH AMERICAN   6    2219                                 000007
       -.00243           .64199            31.70955     NORTH AMERICAN   7    2219                                 000008
4.5    2200000.           1.               1.                                                                      000009
        2.67                                                                                                       000010
              7.         44         3                                                                              000011
26.9    23.3                                                                                                       000012
       1     1           -.148             -.029        1.                                                         000013
       2     3           .584              1.           1.                                                         000014
       3     2           .584              .895         1.                                                         000015
       4     1           .584              .684         1.                                                         000016
       5     1           .455              .584         1.                                                         000017
       6     1           .648              .693         1.                                                         000018
       7     1           .395              .699         1.                                                         000019
       8     1           .488              .563         3.                                                         000020
       9     1           .235              .509         1.                                                         000021
       10    1           .509              .627         2.                                                         000022
       11    1           .434              .509         1.                                                         000023
       12    1           .364              .69          1.                                                         000024
       13    1           .133              .364         1.                                                         000025
       14    1           .364              .482         6.                                                         000026
       15    1           .304              .364         1.                                                         000027
       16    1           .307              .756         1.                                                         000028
       17    1           .316              .527         1.                                                         000029
       18    2           .545              .708         1.                                                         000030
       19    1           .334              .617         1.                                                         000031
       20    1           .401              .512         7.                                                         000032
       21    1           .127              .548         1.                                                         000033
       22    1           .229              .377         48.                                                        000034
       23    1           -.006             .340         1.                                                         000035
       24    1           .13               .244         35.                                                        000036
       25    1           .078              .723         1.                                                         000037
       26    1           .111              .557         9.                                                         000038
       27    1           .187              .377         10.                                                        000039
       28    3           .527              .991         1.                                                         000040
       29    2           -.12              .883         1.                                                         000041
       30    1           .527              .747         1.                                                         000042
       31    1           -.148             -.029        1.                                                         000043
       32    1           .557              .846         1.                                                         000044
       33    1           .509              .880         1.                                                         000045
       34    1           .331              .527         1.                                                         000046
       35    1           .527              .617         19.                                                        000047
       36    1           .464              .527         2.
INPUT FILE     0         1         2         3         4         5         6         7         8         9          OUTPUT FILE
RECORD NUMBER  1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890   RECORD NUMBER
```

PCN N102001

52

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PREPARED: 73 SEP 17                         MEDIA CONVERSION LISTING          LABEL/ CARDS                  PCN N102001

  INPUT FILE   0         1         2         3         4         5         6         7         8         9             OUTPUT FILE
RECORD NUMBER  1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890   RECORD NUMBER

                 37      1         .482                .81                  1.                                           000048
                 38      1         .581                .687                 1.                                           000049
                 39      1         .322                .702                 1.                                           000050
                 40      1         .395                .449                 9.                                           000051
                 41      1         .431                .59                  5.                                           000052
                 42      1         .461                .545                 29.                                          000053
                 43      1         -.148               -.029                1.                                           000054
                 44      1         -.136               -.039                1.                                           000055
                   1     1                                                                                               000056
                   2     1                                                                                               000057
                   3     2    1                                                                                          000058
                   4     1                                                                                               000059
                   5     3    1                                                                                          000060
                   6     1                                                                                               000061
                   7     1                                                                                               000062
```

53

APPENDIX III

LIST OF COMPUTER PROGRAM SYMBOLS AND DEFINITIONS

A	Coefficient of the x^2 term in the equation of a line on a constant life fatigue diagram where minimum stress is x and maximum stress is y. $(R = Ax^2 + Bx + C - y)$
AA	An assigned value of +1. or -1.
AAA	A stress used in the calculation of plastic strain.
ABDIF	The absolute value of DIF.
ABM	The absolute value of ASMAX or of ASMIN, as assigned.
ABMAX	The absolute value of ASMAX.
ABMEAN	The absolute value of ASMEAN.
ABMIN	The absolute value of ASMIN.
ABR4	The absolute value of R(4).
ABR7	The absolute value of R(7).
ABS	The name of a routine calling for the absolute value of a quantity.
AKT	Stress concentration factor, K_t
ASE	Array of values of ENN, for the plotting subroutine.
ASMAX	The product (AKT) (STMAX)
ASMEAN	The quantity (ASMAX + ASMIN)/2
ASMIN	The product (AKT)(STMIN)
ASN	Array of values of ASMIN, for the plotting subroutine.
ASX	Array of values of ASMAX, for the plotting subroutine.
AVSGMN	Average value of SIGMIN over an interval.
AVSGMX	Average value of SIGMAX over an interval.

B	Coefficient of the x term. (See A.)
BBB	A stress used in the calculation of plastic strain.
C	The constant. (See A.)
COFMAN	Inverse of the Coffin-Manson slope.
CYCINT	The number of cycles in an interval.
CYCLES	The calculated number of cycles expected to be indicated on a constant life fatigue diagram for the applied combination of maximum and minimum stress.
C1	The Residual Stress Relaxation Constant (See ENEP.)
DAM	Damage.
DECK	Decimal or real value of integer K after conversion.
DEL2	A portion of a least-squares-method solution.
DIF	The difference between residual stress and equilibrium residual stress. (RES(I) - EQRES)
DO2	A portion of a least-squares-method solution.
DUMMY	A variable used in the calculation of the number of cycles to be considered as an interval for relaxation determination.
ELMOD	The elastic modulus.
EN	The number of cycles from the beginning of the relaxation process to the end of the current interval.
ENEP	The number of cycles required for overload residual stress effect to return to within one-tenth of its original difference from equilibrium conditions. ($N_{ep} = C1/(ABM)^{E1}(ABMEAN)^{E2}$)

ENN	The number of applied cycles at a load level.
ENNCYC	The ratio of the number of applied cycles to the number of cycles to failure. (ENN/CYCLES)
EPSD	LCF strain intercept.
EQRES	Equilibrium residual stress.
EX	An exponential function depicting the relaxation of residual stress.
EXP	The name of a routine calling for the exponential value of a quantity.
EXPO	An exponent. The power of 10 which indicates the number of cycles to failure.
E1 E2	Residual stress Relaxation Exponents.
FLOAT	The name of a routine calling for integer-to-real conversion.
I	A variable subscript.
IBLOCK	The identifying number of a block the blocks being numbered consecutively from 1 to NBLOCK.
IFIX	The name of a routine calling for real-to-integer conversion.
IN	The number of steps input to the range pair counting subroutine.
IPRINT	Value controlling the WRITE statements.
IRAIN	A counter.
IRPCM	Value controlling entry into the range pair counting subroutine.

ISTEP	The identifying step number, the steps being numbered from 1 to NLEVEL.
ITYPE	The identifying type number, the types being numbered from 1 to NTYPE.
J	A variable subscript.
JA	Value of +1 or 0, as assigned for branch determination.
JB	Value of -1 or 0, as assigned for branch determination.
JJ	An index variable.
JJJ	An index variable.
JKL	An index variable.
K	An index variable.
KK	An index variable.
KPMAX	The number of steps output from the range pair counting subroutine.
L	An index variable.
LMN	An index variable.
M	An index variable.
N	An index variable with values of N=4-7 indicating the power of 10, and thus identifying a particular life cycle curve.
NBLOCK	The total number of times to execute a block of loads.
NDECK	The number of data decks to be run sequentially.
NFLAG	An integer used as a counter.
NFLAG2	An integer used as a counter.

NLEVEL	The total number of steps, or levels, of loads in a block.
NN	A subscripted variable used to indicate which types of loads are experienced in which blocks.
NTYPE	The total number of different types.
PLSTRA	Plastic strain.
R	Residue term in damage calculation.
RES	Residual stress.
RNCYC	The number of cycles for a level after exitting the range pair counting subroutine.
SIGMAX	Maximum stress.
SIGMIN	Minimum stress.
STMAX	Maximum applied stress.
STMIN	Minimum applied stress.
SUMDEL	Summation of damage for a flight.
SUMENN	Accumulated total of applied cycles. (Summation of ENN).
SUMNC	Accumulated cycle ratio. (Summation of ENN/CYCLES).
SUMR	Summation of R(N), N=4,7.
SUMRN	Summation of nR(N), N=4,7. n=4.
SUMR2	Summation of $R(N)^2$, N=4,7.
SUMR2N	Summation of $nR(N)^2$, N=4,7. n=4.
SUMR3	Summation of $R(N)^3$, N=4,7.
SUMR4	Summation of $R(N)^4$, N=4,7.
TITLE1,TITLE2	Identification of the source of the SN data.
TLL	Tensile load limit.
TM1,TM2	Material type.

TTYS	One-fifth of tensile yield stress.
TYS	Tensile yield stress.
T1,T2,T3,T4,T5,T6,T7,T8	Test identifying information.
X	Variable equivalent to SIGMIN.
Y	Variable equivalent to SIGMAX.

APPENDIX IV

FATIGUE LIFE INPUT DATA FLR SEVERAL MATERIALS

MATERIAL	YIELD STRESS	STRAIN INTERCEPT	INVERSE OF SLOPE	LIFE, 10^I	S-N LIFE COEFFICIENTS A(I)	B(I)	C(I)
2024-T4	58.	0.4	-1.836	4	-.0020	.2091	62.6
				5	-.0032	.4366	51.4
				6	-.0035	.6207	42.2
				7	-.0042	.7003	36.1
2219-T851	55.	0.4	-1.836	4	-.0022	.2204	55.8
				5	-.0018	.3320	48.3
				6	-.0015	.4628	39.7
				7	-.0024	.6420	31.7
7075-T6	72.	0.4	-1.836	4	-.0020	.2801	71.7
				5	-.0022	.5154	56.3
				6	-.0014	.6141	44.6
				7	-.0013	.6838	38.1
RQC-100	125.	0.54	-1.493	4	0.0	.2136	98.3
				5	0.0	.2927	88.5
				6	0.0	.3669	79.1
				7	0.0	.4376	70.3
Man-Ten	55.	1.11	-1.667	4	0.0	.2257	63.5
				5	0.0	.3520	53.1
				6	0.0	.4669	43.7
				7	0.0	.5678	35.4
4340 Steel	160.	0.4	-1,836	4	-.0002	.2567	162.4
				5	-.0007	.5248	126.9
				6	-.0005	.5557	113.5
				7	-.0005	.5557	108.5
Ti-6-4	158.	0.4	-1.836	4	-.0009	.2368	154.2
				5	-.0006	.4640	110.3
				6	-.0000	.4650	88.9
				7	.0001	.4752	84.2